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LEWIS RADCLIFFE

THE DEATH OF DR. LEWIS RADCLIFFE, just prior to the 1950 meeting, resulted in the loss to the Gulf and Caribbean Fisheries Institute of an ardent supporter. Dr. Radcliffe attended the first session of the Institute in 1948, and because of his special interest in Florida, resulting from his positions as Director of the Sponge Institute and the Oyster Institute, he supported the Gulf and Caribbean group in many material ways. Dr. Radcliffe was to have been Chairman of one of the sessions during the 1950 meeting, and his presence and council were missed at that time. Members of the Institute join in voicing their sincere regret over the passing of this outstanding fishery expert.

ACKNOWLEDGMENT: Sincere thanks are extended to organizations and individuals who have made generous financial contributions to the Gulf and Caribbean Fisheries Institute, and in particular to Mr. Francis W. Taylor, President, Warren Fish Company; Mr. Max Swartz, President, East Coast Fisheries; the Gulf States Marine Fisheries Commission; and the Atlantic States Marine Fisheries Commission.

MONDAY—NOVEMBER 13

Welcoming Address

H. Franklin Williams

Vice President, University of Miami, Coral Gables, Fla.

It is a most pleasant duty to extend to all of you the welcome of the University of Miami, and of Dade County, and the Miami area. But I feel in one sense out of place in doing it, for a glance at the program shows that this is not a program which the University of Miami offers to you. On the contrary, you are the program. The Gulf and Caribbean Fisheries Institute is the product of cooperative effort among many groups representing many different ideas and aims. To me, the cooperation is almost as interesting as the important subjects which you will discuss in your specialized meetings.

You have here the cooperation among the scientists, the government administrators, and the fishing industry. It is conceivable that each of these groups might go its own way. The scientists could pursue their researches in taxonomy and physiology and anatomy. They might publish their results, with all the apparatus of scholarship, paying little attention to the possible usefulness of the information. But the scientists here assembled are too well endowed with common sense to disregard other interests. They know that government and industry need them to do effective work. They know that some of their work will require cooperation from the other groups. Statistical research, for instance, depends on cooperation. They know, too, that a scientist who can impress his fellow scientists with "a thin film of text over a chilly depth of footnote" can give the same scrupulous attention to accuracy, the same integrity, the same standards, to articles and discussions designed to carry scientific information to a wider audience. They are not writers who feel free to be careless in a "popular" article, but true scientists wise enough to bring their research to those who can apply it. In the same way, the industry might have feared that government and science were seeking to cripple it. Instead they are here to cooperate.

I am also happy to see that the cooperation is geographical as well. We are delighted to welcome representatives from Martinique, Bermuda, the Bahamas, Cuba, Puerto Rico, Surinam, and the Barbados. This Institute has become so international that the United States State Department is represented by Dr. Wilbert M. Chapman, a distinguished fisheries scientist in his own right. We welcome also legislators and state fisheries men from the Gulf States and the Atlantic States of this country. Those two regions, by the way, demonstrate cooperation in the Atlantic States Marine Fisheries Commission and the Gulf States Marine Fisheries Commission, both of which are represented here. Universities from Florida to Texas and from Washington to Cuba have representatives at this institute.

If I were to acknowledge the work of those who cooperate here I would need to name all of you and all the bureaus, companies, and laboratories which you represent. But a few I must mention, who have contributed mightily to the success of this Institute.

The Florida State Board of Conservation, headed by Mr. George Vathis, has worked not only on Florida's problems, but on interstate fisheries problems also. Mr. Vathis joins with the University in bidding you welcome.

The United States Fish and Wildlife Service has been a vital factor in successive Gulf and Caribbean Fisheries Institutes. Its Assistant Director, Mr. Milton C. James is here. So also are Mr. A. W. Anderson, Chief of the Commercial Fisheries Branch, and Dr. Richard A. Kahn, Chief of the Economic and Cooperative Marketing Section. Dr. Kahn is a member of your executive committee and has put much of effort and interest into the Institute.

From the side of industry, I can mention only a few of many names. Mr. A. J. Wegmann from New Orleans and Mr. Max Swartz of Miami have contributed much to Institute activities. Mr. Charles E. Jackson of the National Fisheries Institute has also been most helpful.

I feel sure that you will forgive me if I indulge in local pride by giving some praise to Dr. F. G. Walton Smith and his staff in the Marine Laboratory of the University of Miami. We are proud of the Laboratory, of its staff, and of their work. In the fear that they may not speak of themselves, I would like to remind you that they are largely responsible for the detail work of this meeting and its predecessors. They do not mind the work involved, nor does the University begrudge the time that they give to the Gulf and Caribbean Fisheries Institute. For they are serving the scientific and regional aims that the University sets high among its goals.

On behalf of the University of Miami and on behalf of its Marine Laboratory I bid you most heartily welcome. I hope that you will find your meetings interesting and profitable and enjoyable. I hope that your common effort will bind you together for the good of science and of the industry. And I hope that you will come back often.

Opening Address

J. L. BAUGHMAN, *Chief Marine Biologist*
Texas Game, Fish & Oyster Commission, Rockport, Texas

ON THIS, THE THIRD ANNUAL MEETING of the Gulf and Caribbean Fisheries Institute, it is most impressive to reflect upon the progress made since that day in 1948 when Dr. Walton Smith stood before you and made the first address to this assemblage. Noteworthy as that first gathering was, compared to the group now present, it was a very small beginning. However, so important was the exchange of ideas, and so much did everyone gain from it, that the word spread, slowly but surely. At the second meeting there was a considerably augmented attendance, with many more organizations represented. That growth has continued, and this Institute is rapidly becoming a common meeting ground for working fisheries biologists and administrators, for members of the industry, sportsmen, and scientists. All these people are bound together by one common impulse, the sane logical development of the Gulf and Caribbean area so that it will contribute a maximum of food and recreation for our rapidly increasing populations without, however, the serious and senseless depletion of its resources attendant upon uncontrolled exploitation.

This is a remarkable record, and a great tribute to Dr. Smith and to Dr

Richard Kahn, who recognized the need satisfied by this Institute, and whose foresight and energy have made it possible.

Impressive as the growth of the Institute has been, even more impressive is the growth of knowledge of the area in question, and of the development of research facilities in those lands encompassed by it.

Twenty or thirty years ago, the record of research will show that the great majority of available information consisted of taxonomic and distributional lists of animals from various parts of the Gulf and Caribbean, of occasional local surveys by the U. S. Bureau of Fisheries, and records of oceanographic work done by such expeditions as those of the *Blake, Pawnee,* and *Atlantis.* Even so, except for occasional highlights, our knowledge was exceedingly spotty and ill organized, being scattered throughout numerous and sometimes obscure publications, requiring a vast amount of time and patience for their assembly.

As late as 1940, there were few fisheries laboratories either. The writer knows of none throughout the major portion of the territory to the southward, and those existing along the continental coast of the United States could be numbered on the fingers of one hand.

Today the picture is entirely different. The first real sign of change from the attitude of comparative indifference to Gulf and Caribbean Fisheries was the assignment of the *Pelican,* under the able leadership of Anderson and Lindner, to an exploration of the shrimp fishery of the Atlantic and Gulf coasts.

A little later, about 1936, two Japanese ships, the *Minowa Maru* and the *Sapporo Maru,* operating under an arrangement with the Mexican government, carried on rather extensive surveys in some portions of the Gulf. Unfortunately, so far as is known, no detailed account of their findings was ever published.

Beginning with World War II, however, interest in development of the fisheries became intense and the Caribbean Commission, the U. S. Government and various South and Central American countries became vitally concerned with the possibilities of food production in the area. This concern manifested itself by surveys, by exploratory work and by attempts to develop fisheries. With the cessation of hostilities, these attempts were, to a large extent stopped. However, the Caribbean Commission has continued its work, although hampered, and an abortive attempt was made, under the auspices of the Rockefeller Foundation, to establish a fishing industry in Venezuela.

Nevertheless, the seed has been sown, and fisheries investigation and development have gone forward apace, particularly along the Gulf coast.

In 1946, only the laboratories of the University of Miami, and the U. S. Fish and Wildlife Service Laboratory at Pensacola, were in operation. Alabama and Mississippi had no marine biologist, Louisiana was represented only by our distinguished colleague, Dr. Gowanloch and in Texas we had a tiny cement building, which had running water only when it rained, and one old boat that took three days of preparation to get it to run.

Today the picture is far different. Florida now has four marine laboratories in operation, Pensacola, Tallahassee, Miami, Sarasota, besides an oceanarium; Alabama has one; Mississippi has two; Louisiana has two. In Texas we have two, and an active school of oceanography.

Oceanographic research as well as more specialized projects on mullet, menhaden, sponges, crabs, channel bass, weakfish, and shrimp, are all going forward.

The U. S. Fish and Wildlife Service boat *Oregon* is rapidly prosecuting exploratory work on shrimp, and is soon to be joined in the western sector by

the Texas Game, Fish and Oyster Commission boat *Carey*. Moreover, the *Alaska* is almost ready to begin her biological work in the Gulf.

Along different lines, but equally important, is the formation of the Gulf States Marine Fisheries Commission, a commission patterned on that of the eastern seaboard, having as members the five Gulf States, and dedicated to the intelligent use of our marine resources.

Truly, we have come a long way since 1946, in our area, and not the least step was the formation of this Gulf and Caribbean Fisheries Institute, where our common problems can be discussed. If our southern members from the islands, and from the various South and Central American countries, have not been so fortunate, let us hope that, through their participation in these meetings, we may find ways to aid them so that all of us may, through the knowledge so acquired, reach our common goal, the proper utilization of our fisheries.

MONDAY—NOVEMBER 13

Chairman—CHARLES E. JACKSON, General Manager, National Fisheries Institute, Washington, D. C.

The Future Of The Red Snapper Fishery

FRANCIS TAYLOR, *President, Warren Fish Co., Pensacola, Fla.*

IT SHOULD BE SAID at the outset that the writer has no idea as to what the future of the red snapper will be. However, certain speculations can be made which may be of interest.

The history of the red snapper industry dates back some seventy-five years when the pilot boats off Pensacola started fishing for red snapper while waiting for sailing vessels that they could pilot into Pensacola harbor. Initially these fish were brought to Pensacola and consumed locally; however, two enterprising Yankees arrived, built fish houses, imported natural ice from Maine and began to ship the fish inland. Gradually these companies, Warren Fish Company and E. E. Saunders & Company, accumulated fishing vessels of their own and at one time Saunders had as many as forty fishing vessels working. The fleet of Warren Fish Company never was quite so large but at one time it comprised a great many more vessels than at present. During this period the vessels were all propelled by sail. Good seamen were always available from among those who deserted from the sailing ships which were always so numerous in the harbor. During this period both companies flourished. As time passed because of new immigration laws, the sailing ships disappeared and fishermen became scarcer. The fishing fleets gradually became smaller as vessels which disappeared from the fleets were not promptly replaced. In the meantime, numerous other companies entered the field of production of the red snapper. Their efforts probably have helped the industry as a whole, even though some of them have provided stiff competition.

The industry has had serious problems. Among these have been a shortage of fishermen, the cost of replacing vessels, increased express rates, and, later the increased importance of packaged fish. Nonetheless, the fishing has survived, and its future seems quite bright despite the problems which have to be solved.

There are two principal factors which will probably prevent the complete collapse of the industry. The first and most important one is the excellence in terms of flavor and keeping qualities of the red snapper itself. The second is the number of tourists from inland who come to the Gulf each year to fish for red snapper, and who carry both their experience and their fish back home. An industry does not sit still, and there have been many changes in methods of operation since the early days, and the writer foresees many more changes yet to come.

It is unlikely that filleting of red snapper will be one of the changes because of the cost of production, which would make packaged red snapper too expensive for the average housewife. Nonetheless, boneless snapper tenderloin at $1.00 per pound is actually better value than drawn fish at .30c. Some of the

changes which have come into being to date are the reduction in the amount of sail used and the installation of Diesel engines. Further, the installation of sonic depth finding equipment and the use of two way radio are both increasing. The installation of engines has not increased the amount of fish produced, as we had originally anticipated, but by decreasing the sail area there has come about a reduction in the upkeep on rigging, etc. It is likely that the overall cost of operating has not been materially increased, and trips are made more regularly by increased use of power boats. The addition of sonic equipment has greatly facilitated the finding of more fishing grounds and there are many captains who would not go to sea without this additional aid.

The market for the product has nearly always been in excess of production. Our sales manager has often stated that if we could always have a supply of first quality of fish on hand the job of selling would require little effort.

A problem facing the fishery at present is cost of production. The present production methods are all hand work and both slow and tedious, and the equipment used is expensive to operate and maintain. However, there is hope that electric reels can be constructed to increase the catch materially even to the point of doubling the production of each vessel per trip. A further possible improvement is the use of antiseptic ice. Fish spoilage is from two sources. The first is chemical decomposition and the second is the result of bacterial action. Recent technological studies seem to prove conclusively that fish flesh itself is sterile and that deterioration and spoilage occurs through the action of bacteria which penetrate from the outside. If, therefore, the development of these bacteria can be substantially retarded, the "useful" life of the fish can be correspondingly prolonged. The writer is quite convinced from the experiments which the Warren Fish Company has carried on that there are chemicals which can be added to ice which will materially reduce the bacterial growth, which in turn will mean the landing of first quality fish, even though the vessel has remained longer at sea than she should have. In this particular field there is a great deal of worthwhile research work necessary. On the Pacific Coast there is a product called Nobac Ice which so far has not proven particularly successful. However, from the few experiments by our company, there appears to be a great future for some such product. It should be kept in mind, however, that the fish have to receive *other than* a warm reception from the time they leave the water until they are delivered to the ultimate consumer. It is discouraging to see fish unloaded at a dock in poor condition purely from lack of care. Some of our experiments have definitely proven that the quality of fish can be maintained if they are properly taken care of from the time they leave the water until they reach the dock.

It is fully appreciated that it is not usually good practice to have a vessel equipped for doing several different types of fishing, because there is always a doubt as to what type of fishing she should be engaged in. However, it appears that with the rapid increase in the number of vessels being added to the shrimp fleet, sooner or later it would be more profitable for some of these vessels to fish for snapper during certain seasons of the year.

If a shrimper were properly designed so that she could carry a larger crew and if the vessels were equipped with electric reels, they could very profitably operate as a part of the red snapper fleet.

In this connection it is urged that any such vessels arrange to fish for some wholesale plant that has an outlet for red snapper, for the reason that such a house has regular channels of distribution and can afford to pay more for the

catch. Also, the small fish houses which only occasionally get in such fish usually dump their merchandise for what they can get for it, thus demoralizing the market for those who handle the product regularly. The customers inland would prefer to place their orders with those companies who can be reasonably expected to supply their needs.

Any inland distributor who handles red snapper regularly is in favor of the comparatively stable prices maintained throughout the red snapper industry, rather than the rapid and wide fluctuations in the prices of some other varieties. Spanish mackerel is a glaring example of a fish which fluctuates greatly in price, so that the buyer scarcely knows from one hour to the next what the market may be, or what his competitors may have paid.

A good deal of the success of the red snapper industry to date has been in the cooperation between the companies involved. For example, it may surprise you to know that our sales manager disposes of the catches of three or four of our smaller competitors. By moving a larger volume of fish in this way through one outlet, the producers get more orders and a greater demand for their products, and the advantage to us arises out of the more dependable supply provided our customers.

Of course, the red snapper industry exists because people eat fish. And following the same line of reasoning, the greater the demand, the more successful will fish dealers be. The same cooperation which has proven so successful in this industry should be extended to all branches of the seafood industry, and all would profit thereby.

Some three years ago the National Fisheries Institute was formed for the specific purpose of acting as a coordinating agency for the entire industry, and in this objective it has done an outstanding work. It needs more members, more financial support, and it is urged that all dealers become associated with the organization's activities.

To sum up: the writer is more than convinced that if the dealers cooperate and produce fresher products, thereby creating more demand, the future of the red snapper industry along with that of its friendly competitors will be a happy one.

Problems Of Administration And Transportation In The Wholesale Fisheries Industry

A. J. Wegmann, *President, Bagille's Seafood Company, New Orleans, La.*

Two principal problems confronting the wholesale fish business are those of administration and transportation.

The problem of transportation is undoubtedly the greater. Since April, 1940, the writer has participated in two hearings before the Interstate Commerce Commission on controversial rate increases by the American Express Agency. In the matter of iceing charges the industry was successful in defeating the proposal. In June of this year dealers opposed a suggested increase in minimum billing weights, which at this writing has not been decided. In issues of this type the industry is constantly on the defensive and is continually battling for its existence. Transportation costs have increased so extensively since 1946 as to make them a definite threat for future business. In many cases these

charges are equal to the purchase price of the seafood, and sometimes are as much as twice the original cost. This creates difficulties in pricing for resale and frequently eliminates an article from general usage, or, at least, places the con summer price above the average budget allowance. Recently a nationally distri buted newspaper article states that "the consumer paid six hundred million dollars for seafoods for which the fishermen received only two hundred million dollars." No mention was ever made of the costs of handling, cleaning, etc. necessary before the consumer received the finished product. And few peopl probably gave a thought to transportation costs, which play an important par in the final selling price. A conservative guess would be that at least 25 per cen of the consumer price could be charged to this item. This would account fo the large difference cited between fisherman's price and consumer price. Surely scientific research by Governmental authorities would appear in order for thi problem.

Trucking facilities, in the recent past, have lowered transportation cost considerably. But this method of transportation has not solved the problem Usually trucks handle only full loads between points. Some express trucks wil take partial loads on long hauls, but with no guarantee of delivery date. Thi is done, usually, at the convenience of the trucking company. "Drop ship ments," to interior points, are not acceptable. The only present means o handling such shipments is the Railway Express Agency. Air transportatio facilities cannot cope with this situation at present. Truckers have taken ove heavy shipments from the Railway Express Company, leaving them only th smaller drop shipments. These drop shipments are an important part of th seafood business. There is an imminent danger that the American public wi rapidly become a consumer of frozen seafoods and that our children will neve know delectable taste of fresh seafood. Scientific research of this problem another must, and it must be done quickly.

Trucking transportation has created a serious problem. It will take billion of dollars to replace highways throughout the country which have bee damaged as a result of heavy trucking. Even the new Pennsylvania Pike showing signs of definite wear. This is a super express highway engineered an built for the purpose of withstanding heavy loads and only recently opened. N concrete or macadam highway will ever stand up under continual poundin from trucks carrying twenty to thirty tons, days and night, in all kinds weather. The answer again is scientific research into this problem.

The problem of administration is one that can, and should, be solved b the industry itself. However, research can aid considerably even in this fiel The Universities can help by including the problems of the fisheries indust in their curricula. The fisheries support a huge industry, among the ten for most of the nation. The day of the unscrupulous dealer is mostly passed, a though he may still exist in a small way. However, many legitimate dealers fa by the wayside through poor administration. Honest competition is as essenti to any business as is good merchandise. No longer can one pull "fast deal behind fish boxes and in dark corners. Open and above-board dealing throug legitimate channels is essential to survival in the business. The successf dealer is the one who presents his merchandise properly at fair prices, an who makes quality merchandise the basis of his business. If he has learned th value of fair dealing and quality merchandising, he has mastered the prop administration of business.

The Outlook For Breaded Shrimp And Similar Products

MAX MEYER, *President, Meyer Fish and Produce Company, Jacksonville, Fla.*

IN VIEW OF THE CHAOTIC CONDITIONS under which all business is at present operating, we find it easier to talk about the limitations imposed on our work rather than generalize on the broad outlook. If these problems can be solved to the point where they help production, create a better package, lower the sales resistance, and remove objections raised against the product by the consumer and distributor, then we have automatically broadened the sales far beyond anything done so far. Most of these problems are inherent in all frozen foods but breaded shrimp has added a few of its own.

Breaded shrimp processing, to a degree, can be likened to the citrus concentrate industry. Breaded shrimp has been a definitely stabilizing factor in all shrimp producing areas since it has firmed prices on most of the smaller sizes of shrimp ranging from a 35 to 50 count. However, just as there have been repercussions from running the price of fresh oranges from 75c per field crate up to $3.00 and then having to meet a price on processed juice based on 75c fruit, so we are about to run into that same condition in breaded shrimp. When the product first came out on the market three years ago the size shrimp used in processing was bought for 28c to 32c per pound. Since then it has gone to about 42c, and the price of the finished product has been lowered considerably. Sales have not reached a saturation point as yet but at the present rate of growth in increased facilities of old plants, and with new ones about to open up, we anticipate a real competitive market no later than next spring if business in general does not operate under present conditions.

To begin with, the preparation of breaded shrimp in a number of plants has hurt this infant industry. Few plants grade to any particular size in the range of 35 to 50 count in the consumer 10 or 12 ounce size package. A 50 count shrimp cooks much faster than a 35 count and when these mixed sizes are put in one package some shrimp are over-cooked and others under-done. The industry suffers from a lack of minimum standards, and a lot of bad product has been offered to the public. The Department of Agriculture has been careful to initiate reforms for the protection of the consumer and the producer of citrus concentrate and we certainly need some standards in our work or they will either be forced on us or the item will suffer. The excessive amount of breading indiscriminately used by some processors has brought the industry to the point where it stands accused of manufacturing a rabbit sausage made up in equal proportions of one rabbit to one horse. Some plants also use an egg wash to insure plenty of breading adhering to the shrimp. This egg wash is prepared out of frozen eggs that are thawed and then refrozen in the breaded shrimp resulting in an interesting bacteria count. The next step of packaging has kept pace with most of the frozen food work being done on other times but there is room for lots of improvements. We have no sources for research in packaging, so we have to accept what the package trade offers us and to date very little information has been available on what has been done for breaded shrimp. Now that packaging material has practically gone to war there is still less promise of research. For our part we have refused to store breaded shrimp over the country in order to insure our trade with a supply of fresh merchandise. The present packaging materials available are not much protection against excessive dehydration over a period longer than four months storage.

The freezing facilities now in use leave much to be desired. Few plants operate with temperatures running lower than 15 to 20 degrees below zero. A number of them freeze the smaller packages after they are first insulated against a quick freezing job by packing the individual units inside the master container. Since the smaller packages are invariably abused by the store trade in re-handling, the ultimate consumer gets merchandise that is far from desirable. Here again self-imposed or federal freezing standards will protect the consumer and good packer. The consumer living along the seaboard, who is familiar with fresh seafood, has not taken readily to prepared seafoods in a frozen state. This particular group represents our largest per capita seafood consumer, and if a product can be made suitable for them it should provide a much larger outlet than we now enjoy. Proper quick freezing that retains the natural flavors can be one way of opening this sales outlet.

In common with other frozen foods we suffer from very poor truck transportation facilities. It is almost impossible to get small truck shipments direct to independent chains or large institutional users and when they have to compete under the handicap of high cost delivery charges via express they simply show little interest in the item. As soon as the I.C.C. renders a decision on leased trucks on exempt commodities, we should know where we stand. If the decision is favorable it will open up untold sales outlets to all seafood packers, but the idea is being fought most strenuously both by the licensed truckers and unions. Solid truck load rates are very cheap but not many small packers of process seafood can make up $15,000 to $20,000 loads regularly to take advantage of cheap rates. Another disadvantage facing us is the lack of frozen space available in the retail frozen food cabinets.

Since the public has been educated and readily accepts orange juice it is not too difficult to put grape or lemon juice or other juices in a frozen food case, but where a store has never handled shrimp in consumer size packages before, it takes quite an argument to answer the merchant. He points out that he can stock three items of juice which is accepted as part of our daily diet for the price of one package of shrimp, which is not used on the average more than twice a week for the whole family. Our problem is to get our item used on a trial basis and then it will sell itself, but here again the price of our product prohibits free offerings to any great extent.

The public is anxious to find out more about breaded shrimp. There are vast areas unaware of what fried shrimp are and once tasted a lot of free publicity follows. Unlike fruit concentrate it cannot be demonstrated by merely thawing and adding something to it. A number of states and cities prohibit the demonstration of cooked foods in retail outlets where any frying has to be done. A concerted advertising campaign put on by the shrimp trade at large would well repay the effort and expense involved, but for the present we have no group formed to carry this through.

The fillet industry has a successful record of production and sales for over twenty years. Any reputable packer has been able to arrange some financing of his frozen business but it is still limited. With a twenty year record running into millions of pounds sold the fillet processors and distributors have seen the need for trying to get their product listed on commodity markets of the country. If a five or six cent per pound commodity in a raw state has felt the need of financing, one can well understand how much financing an item requires that costs 40c per pound in a raw state.

There are a number of varieties of Florida seafood that can stand further

exploitation by reason of processing, not necessarily by breading. A few attempts have been made successfully on a local retail basis of smoking mullet, Spanish mackerel and shrimp. There is room for putting up a smoked fillet of mullet and spanish mackerel for a selected trade over the country but for the present the shortage of cellophane and other packaging materials prevents that opportunity. In time this can run up into a fair volume, since the fish can be processed from a frozen state in the round. It could be a tremendous stabilizing factor market-wise on our two most important seafood catches. It would be interesting to see how much of the salmon trade Florida mullet could be a substitute for after proper exploitation.

Summarizing the outlook as a whole, we have not touched the barest possibilities open to us in Florida by reason of processing our marine resources. A reasonable approach, taking into consideration the limitations outlined here, can be made on a profitable basis by anyone who has the basic equipment required, access to some capital and a willingness to experiment over a period of time.

The Outlook For Shrimp Production

MAX SWARTZ, *President, East Coast Fisheries, Miami, Fla.*

Abstract

IT IS REPORTED from the various sources in the shrimp producing areas that there is over fifteen million pounds of frozen shrimp in the freezers now—more than there was last year at this same time. It appears that the catches of shrimp have been considerably heavier all along the various production points. The results is that the prices in the past two months have taken a sharp decline anywhere from 10 to 15c a pound on all the different varieties of shrimp caught, such as the pink, the brown and the white varieties.

It appears that a lot of these shrimp buyers, who have formerly bought freely are somewhat holding back on account of this inventory. At the present prevailing market prices on the various shrimp, the prices are lower now than they have been in the past four years. This condition will probably exist at least until the Florida shrimp season closes, which is sometime during the end of February.

It is also probable that by that time the market should get better and the price will improve considerably.

It is known that there is a much greater shrimp fleet working the various shrimp grounds throughout the Gulf as well as the South Atlantic including Dry Tortugas which may possibly maintain a steady flow during the closed season. Last season it was estimated that the Tortugas area alone produced seven million pounds of shrimp during the closed season. With this production in view, it is possible we will not have any skyrocketing prices in shrimp for sometime to come.

However, if the general food commodities like meats, poultry, lamb and other varieties of similar type will increase, it is possible that the shrimp will follow.

As long as it is possible to maintain moderate prices on shrimp to be sold to the various consumers, a high demand for shrimp will prevail.

Today shrimp is considered one of the most outstanding commodities in the seafood industry.

What Does The Future Hold For The Independent Boat Owner?

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BEFORE EXAMINING the problems which may face the independent owner in the future, let us define our terms. By an independent boat owner is meant an individual or small company which owns one or more menhaden boats, shrimp boats or snapper boats but which makes no attempt to process or market its fish. If the owner of a boat has his own facilities for processing his catch he then becomes a small dealer or manufacturer and his problems are beyond the scope of this paper.

Since the writer's experience has been primarily in shrimping and menhaden fishing, it is proposed to limit the remarks to these fields. Further, while the remarks in general may apply to the entire Gulf and Caribbean area, they are based specifically on the East Coast of Florida.

Let us first consider the menhaden industry. From the standpoint of the private boat owner it is indeed a sick business. It is now faced with an acute shortage of colored labor and boat owners find it difficult to fill their 22 man crews. They have encountered the competition of synthetic animal protein factors this past year and have emerged a poor second, just as they came out badly in the competition between fish oil and synthetic detergents for the soap market.

One year ago fish scrap brought $220 per ton; today it sells for half that. In the early summer past, oil sold for 6 cents per pound—when it sold. Today thanks mainly to stockpiling, export demands, and higher over-all fat levels the price of oil has risen to roughly 10 cents per pound and has kept many firms in business.

As though depressed scrap prices were not bad enough, we are now entering a tight labor market. In Florida today colored crews are looking for security and a steady weekly wage in preference to the gamble of menhaden fishing. Since the eight lowest paid men in the crew can only earn a maximum, in Florida, of $800 gross each for a six month season, (from which they supposedly pay for their share of the ship's food bill), it is not surprising that the meanest work ashore looks more attractive. The above returns presume a catch of 10 million fish in six months, a feat that has not been accomplished since the war but which is still held as a goal.

While the menhaden factories, plants which process the fish taken by their own boats, have felt the impact of lower prices and production, coupled with increased costs of production, the independent owner has felt them more severely. Let us digress a moment to describe a small independent menhaden operator so that the picture may be seen more clearly. Most of these men are fishermen who saw an opportunity and seized it. After the war the Navy offered many surplus ships of the 100 foot class, mainly minesweepers or sub chasers at a small fraction of their cost. With only a few thousand dollars involved—rarely more than $20,000—they bought these ships. With the help of the plant operators they set about converting them to menhaden boats, often at cost upwards of $50,000 each. Many people assisted the small independent: friendly shipyards, fuel dealers, marine suppliers and chandlers, for during the war the menhaden industry was a good customer to have. In return for the help offered by the menhaden plants, the independent fisherman delivers fish to them on

60-40 basis. The plant processes the fish, sells the product and pays 60 per cent of the net sale price. By and large such an arrangement is quite profitable to the factory, and can be profitable to the boat owner as well in a good season. However, one important feature should be emphasized. The independent exists and continues to operate only because the factory owners permit him to. At any time, by concerted action, they could easily run him out of business. Hence, he follows factory custom, pays factory wage rates, and generally avoids setting any precedent which might embarrass or antagonize the factory owners.

The two main problems of the independent operator are labor and financing. Some men prefer working on independent boats, since, in theory, they gain closer contact with their employer and can count more on his assistance in their countless personal crises. Somehow, in any event, they do manage to collect crews. The owner's second headache is financing, and usually he is lost without the help of the factory. A menhaden seine today represents $5,000 invested and lasts less than a year. This is a large outlay for a small operator. Further, everything about a menhaden boat is costly. The annual outlay for replacement of gear and maintenance of engine and hull will pay for a fine small home. Hence, the independent occupies a position analagous to a man with only one million dollars who tries to compete with DuPont or U. S. Steel in their field. With the continued forbearance and cooperation of the factories he would probably continue to produce fish, but now economic factors are marshalling which will, in combination, virtually remove the independent from the scene.

Without further elaboration, it is safe to state that the cost of producing fish has increased far out of proportion to the increase in the cost of manufacturing and selling. Therefore, a factory owned fleet of boats can operate at a slight loss for a season, yet the factory will show an over-all profit on its operations, the slack being taken up by the processing operation. When the boat owner loses money his season is a loss; there are no other sources of revenue.

The heaviest expense, one which will continue to rise under our present political leadership, is labor. With a tightening labor supply throughout the country and un-controlled increases in wages and prices, our best men are being forced into other fields in order to make a bare living. Therefore, in order to stay in business, it will be necessary to raise labor rates. But, paradoxically, all prices are rising except those for menhaden products. Technological competition is forcing prices downward, and rising imports are giving them a downward helping hand.

To summarize the foregoing, the independents have an acute problem in financing and credit but the most important problem is labor. There is only one solution to the labor problem: the introduction of modern fishing methods. The menhaden industry is a complex paradox. It employs modern air planes, radios and depthfinders to locate fish and then catches them with pre-1900 methods. A research program is badly needed to work out methods of cutting down our crews to 12 or 14 men, whether through use of the West Coast purse seine gear or power devices in purse boats for handling the net. This work should be started immediately; in a year or two it may be too late. Only one organization, the Fish and Wildlife Service, is presently capable of handling the problem.

Mention should be made of the cost of operation and return per unit of

fish under today's prices. With scrap selling for $120 per ton FOB plant, the breakdown is as follows:

1 million fish produces 70 tons of scrap
70 tons @ $120 . . . . . $8400
60 per cent of $8400 . . . . . $5040

The boat share is thus $5.04 per thousand fish.

In Florida the cost of producing a thousand fish can be approximated as follows:

Labor, Social Security, etc.	$2.75
Nets and gear, salt for net	1.00
Fuel, lubrication, and gasoline	.50
Insurance	.25
Maintenance of ship	.25
Licenses, losses on advances, groceries, etc.	.25
	$5.00

Thus, unless the fish produce a reasonable amount of oil along with the scrap, it is literally useless for the private operator to fish. If the fish produce 3 gallons of oil per thousand we have the following breakdown:

3 gallons produces roughly 23 pounds
23 pounds @ .10 . . . . . $2.30
60 per cent of $2.30 . . . . . $1.38 per thousand, boat share.

If the fish produce 10 gallons of oil per thousand, the average of northern winter fish and of Gulf fish in the summer, we get a better picture:

10 gallons produces roughly 77 pounds
77 pounds @ .10 . . . . . $7.70
60 per cent of $7.70 . . . . . $4.62 per thousand, boat share.

Thus, it can easily be seen that the independent boat must produce fish with at least 3 gallons of oil in order to show a profit and survive the many expensive incidents which overtake him each season. On the East Coast this is virtually impossible south of Chesapeake Bay, since, for some unknown reason, the fish do not store any appreciable quantity of oil during the summer. It would thus follow that independent operators will tend to head for the Delaware area or more than likely, come into the Gulf and fish for plants there.

There is one other alternative open to the independent operator. Since he cannot usually increase the size of his catch he can only try to increase its value. Therefore, instead of having the factory ship his scrap in carload lots to the large consumers at a low price, he might find it feasible to develop markets of his own for small lots of a ton or less, and deliver it direct to small consumers at a price well in excess of that paid by large buyers. This idea does not initially appear un-sound and our firm will attempt it next year.

In this respect, attention should be called to the only new use for fish meal which has been developed in recent years. A hand-full of fish meal mixed with mud and dropped in shallow water will attract all the bait shrimp for quite a radius, and an angler with a cast-net can easily secure the morning's bait supply with one or two casts. Fishing camp operators in Florida have begun selling meal in one pound bags and some operators in the Jacksonville area are buying more than 100 pounds each week. The fact that such a small market even merits attention points up the critical need for more research and promotion if the fish meal industry is to survive.

Let us leave the menhaden industry for the moment and turn to the in-

dependent shrimper. Here there is a much brighter outlook. The independent owner generally captains his own boat and can always pick up a fisherman, no matter how tight the labor supply. Data from companies selling modern 60 foot shrimp boats on generous time payments indicate that an able owner-captain with a good boat can show a net profit of about $12,000 a year. This has applied since the discovery of the new Gulf beds off Key West and Pensacola.

The Florida East Coast needs experimental fishing studies as badly as the Gulf, however. Our shrimp on the East Coast virtually disappear for months at a time, only to reappear after a northeaster. It appears that Gulf shrimp normally found in 50 fathoms of water move into 30 fathom and shallower water during and after storms. May not the same thing happen on the East Coast of Florida? In the absence of other information, is it not possible that somewhere off the East Coast there are undiscovered beds of shrimp such as are being found in the Gulf? Some fishermen have tried shrimping off-shore, usually with negative results. The plain truth is that a commercial fisherman cannot afford to experiment, since he runs too much chance of missing badly needed fish or of losing his crew through discouragement.

The last experimental fishing done on the East Coast was the offshore trawling done by the *Albatross* last winter in North Carolina. The work lasted three weeks and barely scratched the surface. Recent data indicate that since the success of the exploratory fishing in the Gulf that shrimp landings in the Gulf states have increased from 17 per cent to 100 per cent of previous years.

In short, an experimental vessel permanently stationed on the East Coast is needed to handle a two-fold investigation: first, locate and sample off-shore shrimp populations; second, work on the problem of reducing labor requirements in the menhaden fishery and at the same time start a thorough investigation of the life history of the menhaden. It is significant that the last work of importance on the menhaden was done in 1898. We do not presently know where or when they move nor what factors induce their migrations. For example: what are the economic possibilities of *Brevoortia smithii,* the yellow-tailed menhaden found only rarely north of Cape Canaveral, Florida? This large menhaden is commonly taken in shrimp trawls and appears to have an unusually high oil content. Where are its grounds and when does it move? It seldom appears in our fishery because its home waters are beyond the range of our menhaden boats. Recently in North Carolina there have been about 60 menhaden boats. Including boat and plant crews, over 2,000 men are employed in the industry. Men, boats, and factories have been idle because the run of menhaden have not yet appeared. In the past, November 10 has been the approximate arrival of the large fish. This year no one was positive they would appear at all. The willingness to spend large amounts of money on such simple faith has always been characteristic of the menhaden industry and may, some day, lead to its downfall.

To turn briefly to the snapper and hook and line fishermen, there have been a few full-time hook and line fishermen on the East Coast of Florida. When shrimping falls off, the boats occasionally run 30-50 miles off shore for two and three day trips. Good fishermen have landed 4,000 pounds per trip, but the price of about 20 cents per pound to the boat plus the unpredictability of the weather and the bank fishing do not encourage our shrimpers to devote their full time to hook and line fishing. As long as the new shrimp grounds around

Key West hold up, the independent owner will not concern himself with snapper fishing except on a casual basis.

On the East Coast the fishermen have barely scratched the surface of the marine resources, although some species have been fished almost to extinction. On any good fishing day when a hundred miles of coastline has two hundred boats at sea, hardly a boat can be found more than 5 miles off-shore. The boats plow up the narrow strip along the beach and ignore the off-shore waters. No one knows what schools of menhaden, herring, tuna and other pelagic species may exist there. Ten miles off shore the shrimp could be lying in solid beds and would never be encountered except by accident.

The independent boat owner who can keep his boat and crew busy all year round will enjoy the greatest advantage. A menhaden boat which can also engage in the off-shore shrimp fishery should be profitable.

We plan to fish our vessel *Barbet* this winter on the Gulf shrimp. With a weeks time required for the change-over, we feel we can profitably operate for three or four months when we would otherwise be idle.

To sum up the status of the independent boat owner, his continued survival depends largely upon the discovery of new grounds and fish populations, the improvement of menhaden fishing methods and the exploration of our fishing waters as far as the hundred-fathom curve. This can only feasibly be accomplished by the Fish and Wildlife Service with the cooperation of the fishing industry.

The Outlook For Continued Shrimp Production In Louisiana

A. B. Chauvin, *President, Chauvin Brothers, Inc., Chauvin, Louisiana*

The subject is one that is rather difficult to handle because it is very controversial. The writer's opinion about continued production of shrimp in Louisiana might be challenged by others in the industry, and here it is approached from practical experience with no knowledge of biology whatsoever. It is possible that opinions expressed here are contrary to the belief of the men of science who have made a study of the shrimp fishery. These opinions are given from results of many years of experience in the shrimp business, and operating exclusively in Louisiana.

The outlook for continued shrimp production in Louisiana is as good at this time as it has ever been at any time in the past. Only two factors could change the outlook at this time. First, serious damage to the vast nursery grounds whether the damage be from natural or artificial causes. Secondly, overfishing. Since there appears to be no serious damage to the nursery grounds at this time let us consider the fishing effort.

Is there overfishing in Louisiana waters? It appears not, for the following reasons: The industry is divided into two important groups, the inshore fishermen who, with the use of small boats and light equipment, produce small and medium shrimp, and the offshore fishermen who, with the deep sea trawler fish in the Gulf and produce large or jumbo shrimp. From childhood the writer has watched the development of the fishery, starting first with the castnet, then the seine and then the otter trawl, on the inside lakes and bays, down to the

more recent development of the offshore fishery. Since 1923 the writer has been in active charge of the operations of Chauvin Brothers, Inc. and for the past 27 years, then, has listened to and participated in the arguments of what was best for a continued production of shrimp in Louisiana. The man with the small boat, operating the inshore fishery, argues that if closed seasons are necessary for him, they should also be extended to the offshore fishery for protection of the breeding stock. The man with the big boat, fishing offshore, contends that catching of small shrimp is the problem to be controlled; therefore closed seasons should only apply to the inshore fishery. This problem has been argued since the fishery began, and it is doubtful if there has been one single regular session of the state legislature without the battle of a shrimp bill. And what has actually happened? We have fished extensively both the inshore and the offshore fishing grounds, and the writer frankly sees no serious decline in the total production of shrimp in Louisiana. By no serious decline is not meant maintainance of production to the peak figures of the very best years, but fair average production. If then, for the past many years, with extensive fishing both inside and outside, no serious decline in total production is apparent what other conclusion can be arrived at other than that the outlook for continued production is good?

To supplement the production of white shrimp there is very good outlook for development of the fishery for grooved shrimp, or "brownies." Some fishermen have been fairly successful, but since the brownies are found far offshore most of the time large boats and the use of depth finding equipment will be necessary. These requirements are being provided and the fishing for grooved shrimp being rapidly developed.

It is generally felt that to maintain good production in Louisiana certain closed seasons must be imposed. There are presently two such periods governing the inside fishing. The current law is not too far out of line with the recommendations made by the biologists to the Gulf States Fisheries Commission. The recommendations as submitted recently would close our inside fishing for an additional two months, and this would create a hardship on the small boat operator who plays an important part in maintaining the total Louisiana production. If all parties concerned will give this matter careful consideration, looking at the situation on a live and let live basis and all be willing to compromise the issue, it should be possible to bring about better and enforceable regulations which would help distribute in a more equitable way our Louisiana production.

INSHORE AND SHELL FISHERIES SESSION

Chairman—WALDO SCHMITT, Head Curator, Department of Biology, U. S. National Museum, Washington, D. C.

Diseases Of Oysters And Their Relation To The Gulf Coast Oyster Industry

J. G. MACKIN, *Agricultural and Mechanical College of Texas, College Station, Texas*

*Abstract

STUDIES OF DISEASE OF OYSTERS caused by *Dermocystidium marinum* Mackin Owen, and Collier, have shown it to be lethal to oysters, and incidence of infection in Marataria Bay, Louisiana, and environs is sufficiently high to rank the disease as a major agency in destruction of oysters in that region. In areas where it occurs *Thais floridana* probably influences oyster populations to a greater extent than does *D. marinum*. A phase of the studies, that of analysis of pathogenesis, shows widespread destruction of tissues of all major organ systems by lytic action of the fungus cells. Since other relatively little studied diseases of oysters exist on the Gulf coast, it is suggested that further research on disease may be highly profitable.

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Spawning And Setting Of Oysters In Apalachicola Bay, Florida

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*Abstract

OYSTERS SPAWN more or less continuously from the latter part of March until the last week in October in Apalachicola Bay. The peak of spawning is not observed until the water temperature has reached at least 26.5°C. and possibly 28.0°C. At any rate, the critical temperature for mass spawning is higher than 25.0°C., previously accepted as the highest critical temperature for this function in oysters.

Poor quality of oysters was not found to be detrimental to the production of spat.

In some areas spat-fall was so heavy that cultch planting operations would have to be synchronized to avoid the peaks rather than coincide with them as is the practice in northern waters.

"Coon oyster" bars, of presumably no value commercially (except as the source of seed), are capable of heavy spat-fall production. They should therefore be protected, even from the taking of too many seed oysters.

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Measurement Of The Natural Growth Rates Of Decapod Crustaceans

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Fishery biology, insofar as it is a branch of ecology, is largely concerned with the factors affecting the rates of birth, growth and death which govern the species-mass time-derivatives. A peculiarity of the science is that it must often deal with the dynamics of populations which cannot be directly observed. Thus, the correspondence of measurements of population properties which it is feasible to make, with those actually obtaining in the whole population, is usually in doubt.

In some fishes and molluscs, a record of the age and previous growth of the individual is supplied by periodic changes in the structure of skeletal parts. In decapod crustaceans, however, the skeleton is cast off at each change in dimensions of the individual, which increases to the highest degree the difficulty of determining the effect of the fishery on the stock.

Three methods have been used in estimating growth rate of shrimp: (1) growth of captive individuals; (2) growth of tagged individuals; and (3) change in frequency-distribution of sizes in repeated samples of a population.

None of these methods is wholly satisfactory.

Growth in ponds or aquaria yields interesting information which cannot, however, be presumed applicable to the wild populations.

Tagging has an unknown effect on growth, especially where the tag-injury is relatively large. It is an expensive procedure, thus not well-suited to repetition year after year for the purpose of defining variations. Recovery of tags depends chiefly on the fishery, so that stages smaller than are captured for use cannot well be studied. The rate of recovery of tagged shrimp evidently drops rapidly in a matter of weeks, so that adequate growth records would require massive experiments. In shrimp, also, shifts in range are so frequent that tagging is not well adapted to defining growth rate in a given locality at a given time.

Changes in size-frequencies do not necessarily represent growth. In shrimp, young are usually being added in a given part of the range, while at the same time the older individuals emigrate; hence, repeated samples in the same locality do not represent the same population. The rates of mortality and addition of new individuals seem so high for shrimp that it would hardly be satisfactory even to sample the whole population and weight the length-frequencies according to changes in distribution. At the same time, precise interpretation of size-frequency data for shrimp in terms of variations in growth would require corrections, probably large, for changes in mortality-rate at different stages of development (resulting from changes in vulnerability to predation, etc.). This is impracticable, since nothing is known about mortality rates in shrimp except that they must be high at all stages.

The method of measurement of growth rate here described is that of calculation from natural rates of molting and of increase in size per molt. Rate of molting in nature may be determined in two ways: (a) from percentage of soft-shelled individuals (or those at another restricted stage of intermolt cycle) in samples captured; and (b) from frequency of shedding in captive samples during the first day or so. For (a), it is necessary to know the rate at which

hardening of the new shell proceeds; this is variable with temperature and other immediate environmental conditions, and also presumably with previous history of the individual. For (b) it is necessary to know whether capture and brief captivity have a significant effect in advancing or retarding the molt, at advanced stages of preparation for it. As complications, the molting of populations seems often to be periodic, both diurnally and over longer periods; also different types of gear tend to select different molt-cycle stages. Finally, spatial segregation at ecdysis often occurs.

Rate of increase in size per molt can easily be determined only by holding molted individuals till expansion is complete, and comparing with the cast skin. Percentage expansion varies with history and immediate environment. To test whether a short period of aquarium confinement affects expansion rate, it is necessary to compare with results in individuals retained under observation without the shock of capture and transplantation, under conditions in which they would have remained in any case.

Among other complications in use of the method, morphometry demonstrates extensive changes in the body proportions of shrimp. For example, during many molts after the planktonic postmysis larvae of *Penaeus duorarum* settle on the bottom, the nightly ecdysis results in increase of stoutness rather than of length and the customary linear measurements fail to reflect growth. It must also be remembered that expansion is not always the normal result of ecdysis, even in well-fed crustaceans on their native ground. In adult female Caridean shrimp, for example, molting regularly precedes oviposition and follows hatching of the brood, often without appreciable growth. Although the reproductive activities are quite different in Peneids, it would not be surprising if the molt expansion in old spawners of *Penaeus* were very much below the thirty per cent volumetric rate frequent in actively growing juveniles, or zero, or even sometimes negative.

A fishery affects its own potential harvest through the direct or indirect, delayed or immediate, reaction of the rates of birth, growth and natural death to change in mass of the standing crop. According to some estimates from Texas data on shrimp taken per unit of area trawl-swept, and on predation natural and human (of which natural appears the greater), the shrimp stock alive at a given instant is evidently only a small fraction of the total mass produced during the year. At such unprecedented turnover rates, it is especially unsafe to presume that the catch of shrimp per unit of effort could (even in the present high rates of exploitation and on the long-term average) be increased by restriction of fishing, without a more than proportional loss of harvest or reduction in average size of the shrimp caught. Since birth and natural mortality are even more difficult to measure than growth, the detection of variations in growth rate is here of peculiar interest. Preliminary work with the molt-frequency method of growth-rate determination suggests that, despite the difficulties and complications touched upon above, the technique offers a relatively favorable approach to this problem. Apart from the question of variation, it also appears that average individual growth of shrimp may be faster than has been realized.

Results Of Shrimp Research In North Carolina

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INTRODUCTION

THE SHRIMP FISHERY of North Carolina, worth about one and one-half million dollars annually, ranks second in value among the State's fisheries. Although the origin of the shrimp fishery was in the latter half of the nineteenth century, production was low until the otter trawl came into general use after the first World War. The catch, which was 371,000 pounds in 1908, had increased to 940,120 pounds in 1921. Today the catch is over 4 million pounds annually. This figure has roughly doubled in the last decade.

The North Carolina shrimp fishery is actually the sum of four separate fisheries located in three different parts of the State, each having a distinct but short productive season. Each of the four fisheries draws from a separate source of shrimp.

The areas within North Carolina that support shrimp fisheries are the environs of Cape Fear, especially the littoral zone southwest of the Cape; the waters adjacent to Carteret County, including Core and Back Sounds and the oceanic littoral zone from Bogue Inlet to Cape Lookout; and the vast inside waters of Pamlico Sound with its principal tributaries, the Neuse and Pamlico Rivers. Shrimp taken outside of these areas represent a small proportion of the State's catch.

The data reported in this paper were collected by the shrimp staff of the University of North Carolina Institute of Fisheries Research during the years 1948, 1949 and 1950. The author wishes to cite especially the work of Mr. Horace G. Loftin, Jr., who collected the data on commercial catches during the summers of 1949 and 1950.

SHRIMP OF COMMERCIAL IMPORTANCE

Three species of the genus Penaeus make up the shrimp catch of North Carolina. These are: *Penaeus aztecus* Ives; *Penaeus setiferus* (Linnaeus) and *Penaeus duorarum* Burkenroad. Three other peneids. *Xiphopenaeus kroyeri* (Heller), *Trachypenaeus constrictus* (Stimpson) and *Sicyonia brevirostris* (Stimpson), which appear in the catch are too seldom taken to be of commercial importance. Sampling of commercial catches during the years 1948 and 1949 has yielded data on the proportion in which the three species of *Penaeus* occur in North Carolina commercial shrimp catches during the months of the year. By applying these proportions to total catch statistics, an estimate of the proportion of each species in the total catch has been computed. In North Carolina, during the years 1948 and 1949, 68.3 per cent of all commercial shrimp taken were *P. aztecus*. *P. setiferus* contributed 17.3 per cent of the two-year catch and P. *duorarum* accounted for the remaining 14.4 per cent.

Each year the first species of shrimp to appear in commercial abundance in North Carolina is *P. duorarum*. This species, the spotted shrimp, supplies the first of the four shrimp fisheries, a spring fishery. In late May or early June

spotted shrimp are caught in Core and Back Sounds and in the littoral outside* waters from Cape Lookout to Bogue Inlet. These shrimp are first taken inside and later outside. The fishery, from its start until the latter half of June yields entirely *P. duorarum.* After mid-June, brown shrimp (*P. aztecus*) start to appear in the catch. These brown shrimp increase in relative abundance so that, during the first half of July, *P. duorarum* accounts for only one-third of the catch. After July, *P. duorarum* is infrequent in the inside catches until September. During the fall months of September, October and November spotted shrimp supply about 10 to 20 per cent of the yield of a greatly decreased fishery. This species continues through the summer and fall in the outside catches, however, furnishing, after July, less than one-third of the shrimp taken.

Spotted shrimp are never important in the commercial catches from the Cape Fear region or from Pamlico Sound. They occur at Cape Fear in June and in November but comprise a negligible proportion of the catch.

During the June fishery in Core Sound and in the outside water adjacent to Carteret County, there is no evident growth of the spotted shrimp. During the spring run, starting late in May and ending early in July, *P. duorarum* taken in the inside waters average 107 mm. in total length. *P. duorarum* taken from the outside littoral zone during this same period average 112 mm. in length. These averages apply to all samples made from June 6 to July 6.

At the end of June and during the first week of July, *P. duorarum* females from the outer littoral zone, which average about 120 mm. in length, show signs of sexual maturity. The ovaries are enlarged and have taken on a blue green color. At this time there is an increase in the proportion of females over males so that the percentage of females in the total population, which was less than 50 per cent during the first of the run, rises to greater than 50 per cent shortly before the end of the run. This phenomenon occurs shortly before the end of the period of maximum production in each of the North Carolina shrimp fisheries. Regardless of the species of shrimp caught, a predominance of females fortells decreased total yield.

Ripe or ripening females disappear from the catch during the latter half of July. At the same time there is a decrease in the average size of the spotted shrimp so that *P. duorarum* taken in North Carolina during the latter half of July, August and September average from 97.6 to 103.2 mm. in total length. The percentage of the sexes is variable during these summer months.

In early October an increase in average size of spotted shrimp from the littoral zone occurs. This increase continues through November. A general increase of the population mean of 10 mm. every two weeks occurs through mid-November, by which time commercial shrimp fishing has ended. The increase in mean length is accompanied by the reappearance of blue-roed females. Degrees of coloration varying from opaque white to deep blue-green are found in these ovaries. These shrimp average 120 mm. in mid-October and 140 mm. by mid-November. There is a preponderance of females during October and November.

During the past few years, *P. aztecus,* the brown shrimp, has been by far

* The terms "inside," "outside," "inshore," and "offshore" as used here are defined:
Inside: describes bodies of water which are inside the outer banks or other natural shoreline.
Outside: describes ocean waters.
Inshore: pertaining to the littoral zone of the ocean or outside waters.
Offshore: pertaining to ocean waters having a depth of more than 10 fathoms.

ne most important commercial shrimp of North Carolina. Is occurs in all parts f the State and furnishes two summer fisheries, one in the Pamlico Sound and eaufort Inlet areas and one in the Cape Fear area.

P. aztecus first appears in commercial catches in late June in the inside and utside waters around Carteret County. Brown shrimp are found first here only ecause catches of spotted shrimp are being made in these waters before fishing tarts in other parts of the State. Small (80-90 mm.) brown shrimp have been aken by the author from inside waters at Cape Fear as early as June. Although ne winter and spring occurrence of small shrimp has not been studied in North Carolina, it seems unreasonable to assume that other areas later to produce rown shrimp do not have populations of small *P. aztecus* in June. By early uly, brown shrimp contribute two-thirds of the catch at Beaufort Inlet and ontinue to make up from two-thirds to three-fourths of the catch through November.

In July, as the inside run of spotted shrimp ends, the focus of the North Carolina fishery is directed to the Pamlico Sound—Neuse River area. Here a ummer fishery, lasting from the last half of July through mid-September, yields nore shrimp than any other North Carolina fishery. The shrimp taken during his period in Pamlico Sound are 93 to 98 per cent *P. aztecus*. During Septemer, there is a decline in the abundance of brown shrimp in the inside waters nd a corresponding decrease in the proportion of them in the fishery. The September catches yield about 75 per cent brown shrimp. After September, xcept for a late run of white shrimp, there is little commercial activity in Pamlico Sound and accurate percentage figures are not available.

A summer fishery at Cape Fear produces 90 to 99 per cent brown shrimp luring July and August. There is a change in the Cape Fear population during ate August so that September production of brown shrimp at Cape Fear is nly 1.4 per cent of the total catch. This reversal is an expression of both the lisappearance of brown shrimp and the appearance on the grounds of white hrimp. After the end of August brown shrimp constitute a negligible propor- ion of the catch until the white shrimp disappear in mid-November when the roportion, although not the actual number, of brown shrimp rises as the fishery lecreases.

P. aztecus enter the North Carolina fishery at Beaufort Inlet at an average ize of 104 to 107 mm. in late June. The increment in mean size is slight hrough August, at which time the population average is 118 mm. In the nside area, however, brown shrimp which average 113 mm. in early July, verage 140 mm. a month later and 150 mm. by the end of August. In Septemer, there is a decrease in average size of brown shrimp in the sounds. Septemer means from inside areas vary from 103.2 mm. to 139.6 mm. By October he average size of brown shrimp from Beaufort Inlet, however, has increased o 125 or 130 mm. By mid-November, brown shrimp in the greatly decreased atches at Beaufort Inlet average 137 to 140 mm.

At Cape Fear, brown shrimp are always smaller than those from the sounds. Early July *P. aztecus* from Cape Fear average 115 mm. Late August samples f this species average 125 mm. These shrimp are believed to be not migrants rom or to Pamlico Sound but a separate stock.

The larger females *P. aztecus* found in the late August and early September atches show signs of sexual maturity. These shrimp are from 155 to 160 mm. n length. The ovaries are enlarged and pigmented various shades: opaque

white, yellow, tan or gray. Shrimp taken inside seldom have tan or gray ovaries, while those from outside show all degrees of coloration.

About the middle of August, there is an increase in the population of females over males in the inside waters and at Cape Fear similar to the increase of the percentage of female spotted shrimp described above.

The white shrimp *P. setiferus* is of commercial importance chiefly in the Cape Fear area in North Carolina. It supplies the fourth, or fall, fishery. *P. setiferus* first appears in May when a run of sexually mature shrimp of about 160 to 165 mm. in length is fished west of Cape Fear. This run lasts through June with a steady decrease in total yield of the fishery and in average size of the shrimp. A few of these large white shrimp are taken at Beaufort Inlet during the same period. *P. setiferus* is only found occasionally in catches of brown and spotted shrimp during July and August.

In August small white shrimp may be found in the back waters of Pamlico Sound and in the Cape Fear River. Because of their small size and the availability of brown shrimp at this time, these shrimp do not appear in the commercial catches. In late August small white shrimp enter the Cape Fear fishery. As the brown shrimp disappear, the white shrimp enter the fishing grounds. During September, while the species of shrimp caught at Cape Fear is changing, the total catch decreases slightly. The shrimp fishery at Cape Fear has its peak of production during October when 98 per cent of the catch is white shrimp. There is a decline in the yield during November and the fishery ends before December.

In Pamlico Sound white shrimp do not become important until mid-October. Following the decrease in the sound catches of brown shrimp there is a period of inactivity when vessels spread out as the yield from the productive grounds of the summer fishery decreases. In October, schools of white shrimp are encountered in Pamlico Sound and are followed by vessels as they move to the inlets. This fall migration has earned *P. setiferus* the local name of "school shrimp" in the North Carolina sounds. This disappearance of "school shrimp" from Pamlico Sound ends the inside shrimp fishery.

After a summer's absence, white shrimp reappear at Beaufort Inlet during October. They contribute an increasing percentage to the fishery through its end in November. At that time about 20 per cent of the shrimp taken are *P. setiferus*.

White shrimp re-enter the Cape Fear fishery in August at an average length of 140 mm. They increase in number and in average size through the end of October, at which time the mean length is 155 mm. During November the average size decreases as the catches diminish.

White shrimp taken in tributaries of Pamlico Sound in August average 140 mm. in length. Those found at Beaufort Inlet in October average between 150 and 155 mm. There is a decrease in average size during November.

The spring white shrimp encountered at Cape Fear and at Beaufort Inlet have ovaries of the olive drab color described by King (1948). The ovaries of fall *P. setiferus* are undeveloped. At Cape Fear a predominance of female white shrimp occurs in late September or early October.

SHRIMP OFFSHORE OF NORTH CAROLINA

Sampling of offshore shrimp has revealed the presence of *P. setiferus* in the environs of Diamond Shoals and of *P. duorarum* in the vicinity of Cape Lookout Shoals during the winter months. Shrimp found were generally larger than

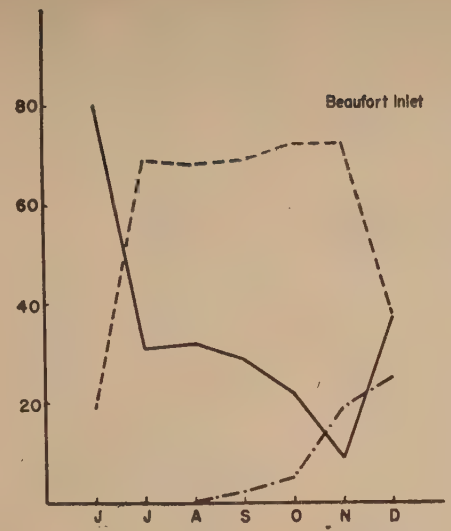

FIGURE 1

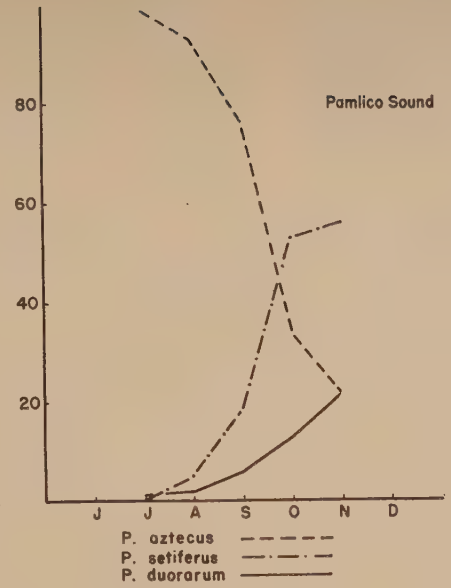

FIGURE 2

FIGURE 3

Composition of total catch by species. Beaufort Inlet, Pamlico Sound and Cape Fear.

those encountered inshore at any time of the year. Commercial quantities of these offshore shrimp were not located.

While the most numerous shrimp of the inshore and inside waters during the summer and fall is *P. aztecus,* that species was found to be least abundant offshore during the winter. *P. duorarum,* the least numerous of the inshore shrimps, was most frequently encountered offshore.

THE CHANNEL NET FISHERY IN CARTERET COUNTY

Burkenroad (1949) has described a fishery for *P. duorarum* which exists in the straits between Harkers Island and Beaufort, North Carolina, and which employs a stationary "submarine" net as a tide trap. This fishery, the earliest productive fishery of North Carolina, lasts from late May through early July. It produces shrimp only during the hours of darkness and only on an ebb tide when the shrimp, swimming "presumably to sea," are carried into the net by the tide.

Samplings from the catch of the channel net fishery have been made during 1949 and 1950. The yield of the channel net is similar, species-wise, to that of the trawl fishery at Beaufort Inlet during the same period. The channel net shrimp average 105 to 110 mm. in length from the start of the season until late June. During this time the channel net yields only *P. duorarum.* In late June *P. aztecus* of about 100 mm. in length enter the catch. By the first week of July *P. aztecus* accounts for two-thirds of the shrimp taken by the channel net. Channel nets are not used after the first half of July.

THE NORTH CAROLINA SHRIMP FISHERY

The statistics assembled by the North Carolina Department of Conservation and Development most readily lend themselves to an analysis of the North Carolina shrimp fishery. These figures are based upon returns from tax tag sales which are rendered monthly by localities and may be converted into pounds of shrimp shipped from all parts of the State. Sampling of catches landed at fish houses in all the important shrimp landing ports has given percentage data on species composition of the catch. The species composition of total catch for each of the three main shrimp producing areas may be illustrated graphically. (See Figures 1, 2, and 3).

By plotting the per cent of the total catch per month landed in each of the three areas, the multi-seasonal aspect of the North Carolina shrimp fishery may be illustrated. It will be noted that the three production peaks fall in June, August and October, the periods of peak production for the three species of commercial shrimps.

RECENT TRENDS IN THE NORTH CAROLINA SHRIMP FISHERY

If the percentage of the annual catch landed each month over a five-year period is plotted against time, the period of maximum production of the North Carolina shrimp fishery as a whole is illustrated. Such production figures for the five-year period from 1941 to 1945 show a peak of production in October. The same figures for the period from 1945 to 1949, however, show the production peak to be in August.

This shift in time of the season of maximum production is a result of the opening of the Pamlico Sound fishery and the increase in the proportion of brown shrimp in the catch.

DISCUSSION

Weymouth, Lindner and Anderson (1933) estimated the percentage of *P. setiferus* in the South Atlantic shrimp catch as 95 per cent. This estimate was reaffirmed by Anderson, Lindner and King (1949) and questioned by Burkenroad (1949) insofar as the figure applies to North Carolina. The present estimate of 68.3 per cent of *P. aztecus* in the North Carolina catch, which covers the two-year period 1948-49, is much higher than Burkenroad's statement that "during the last decade the proportion of grooved shrimp in the annual North Carolina catch has probably fluctuated between a third and a half." A comparison of catch statistics for the first and second halves of the past decade indicates that the present level of brown shrimp production is of recent origin. Species composition percentages are not available to apply to catch statistics for the years before 1948. The seasonal occurrence of the mass

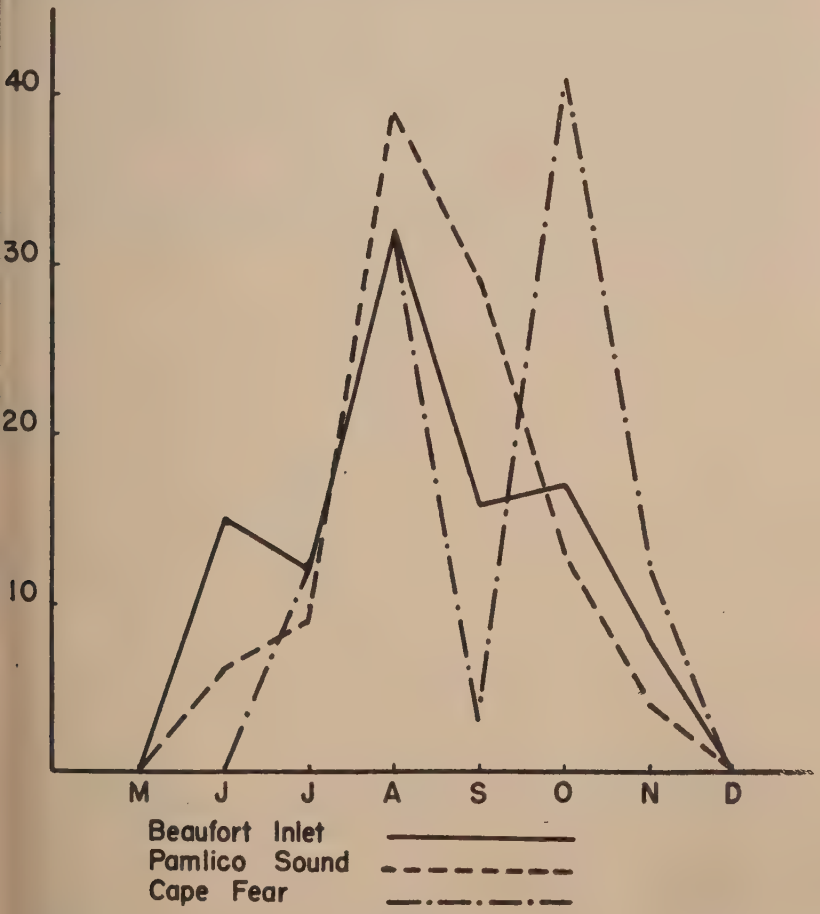

FIGURE 4

Monthly percentage of total catch for each of the three principal shrimp producing areas of North Carolina.

of the population of each species, however, is sufficiently distinct to allow treatment of June shrimp as largely *P. duorarum,* of August shrimp as largely *P. aztecus,* and of October shrimp as largely *P. setiferus.* The 1945-1949 figures, therefore, show not only an increase in *P. aztecus* over the 1941-1945 figures but also an increase in the proportion of *P. duorarum.*

The Pamlico Sound fishery is, in a large part, responsible for this increase in the proportion of brown shrimp in the North Carolina catch. Although there is little agreement among North Carolina fishermen concerning who first shrimped in North Pamlico Sound, there is general accord that no one did much before 1940. An accelerated market for shrimp paid the highest prices in history during the second World War. This demand resulted in exploration and opening up of North Carolina's inside waters by shrimp fishermen. Burkenroad (1949) has suggested an increase in the relative abundance of grooved shrimp. From interviews with fishermen from all parts of the State, such seems most certainly to be the case. There was then an increased demand which coincided in time with the opening of a new area when shrimp of the sort inhabiting that area were becoming increasingly abundant. The result of these fortuitous circumstances is an inside fishery—the only one of its kind on the Atlantic Coast—which produces in a period of two months half of North Carolina's annual catch.

King (1948) described field characters by which the degree of maturity of *P. setiferus* could be judged. Present observations of degrees of pigmentation of ovaries of grooved shrimps suggest that such characters may also exist for *P. duorarum* and *P. aztecus.*

The effectiveness of the channel net has been interpreted by Burkenroad

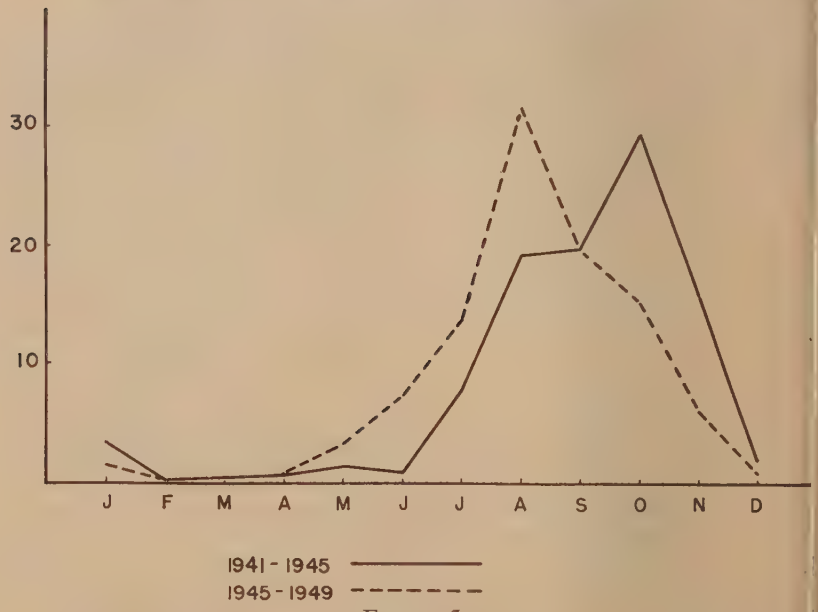

FIGURE 5

Percentage of the North Carolina shrimp catch landed each month. Five-year average.

(1949) as the interception of shrimp swimming off the bottom and "presumably to sea." Fishermen of Carteret County have long noted that heavy catches of spotted shrimp at Beaufort Inlet follow a night of heavy catches in the channel nets in Back Sound. A slightly greater average size of *P. duorarum* from Beaufort Inlet than from Back Sound during June and the stability of these averages through the spring suggest that these are two stations at which a seaward and offshore migration is being sampled. The presence of females with pigmented roe at Beaufort Inlet in late June, with a few such blue-roed females coming from the channel nets relates this migration to approaching sexual maturity.

The fall reappearance of blue-roed *P. duorarum* females may represent a portion of an offshore breeding stock driven in by conditions coincident with the changing of the season. This behavior is at variance with Burkenroad's (1939) observation that, in Louisiana, *P. duorarum* "retires permanently to deeper waters after a littoral youth."

The presence of yellow and tan-roed female *P. aztecus* in the late August catches suggest the September disappearance of this species is related to approaching maturity. If the migrations that remove grooved shrimps from the North Carolina littoral zone may be thus related to spawning activity, then the observed increase in the proportion of females in the catch may be interpreted as differential behavior of the sexes at the approach of sexual maturity. The high percentage of female white shrimp in the October population at Cape Fear, however, cannot be related to such macroscopically observable indications of approaching maturity.

BIBLIOGRAPHY

ANDERSON, W. W.; M. J. LINDNER and J. E. KING, 1949, *The shrimp fishery of the southern United States,* U. S. Fish and Wildlife Service, Commercial Fisheries Review, 11 No. 2, 1-17.

BURKENROAD, M. D., 1939, *Further observations on Penaeidae of the northern Gulf of Mexico,* Bull. Bingham Oceanog. Coll., 6, 1-62.

BURKENROAD, M. D., 1949, *Occurrence and life histories of commercial shrimp,* Science, 110, 688-689.

KING, J. E., 1948, *A study of the reproductive organs of the common marine shrimp,* Penaeus setiferus (*Linnaeus*), Biol. Bull., 94, 244-262.

WEYMOUTH, F. W., M. J. LINDNER and W. W. ANDERSON, 1933, *Preliminary report on the life history of the common shrimp,* Penaeus setiferus (*Linnaeus*), Bull. U. S. Bur. Fish., 48, 1-26.

Variation In Salinity And Its Relation To The Florida Oyster

Salinity Variations In Apalachicola Bay*

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SEVERAL OF THE ESTUARIES of Florida are not well protected. Water from the rivers many times enters the Gulf and Atlantic abruptly and without an opportunity to become uniformly mixed.

*Contribution No. 46 from Marine Laboratory, University of Miami

Much of the present-day oyster industry of Florida is centered in estuaries which do not provide a constant and uniform salinity. Variations exist not only seasonally, but daily and tidally.

Biologists and producers alike would be benefitted by a knowledge of the magnitude of variation which oysters can tolerate in Florida's sub-tropical waters, and what degree of variation can be considered optimal for reproduction, deposition of glycogen, maximum growth, etc. The present study was carried out to establish, if possible, the critical values for salinity variations as they affect oyster well-being.

Procedure

Salinity studies (by hydrometer) were made on a series of habitats ranging from the poorest to the best with regard to commercial production. Density was obtained for other stations frequently, and there were several sets of paired readings run on consecutive high and low tides. In some instances salinity tests were run on bottom and top samples hourly for a 24-hour period. The studies were carried on for a period of eighteen months (February, 1949, to July, 1950). Where practical, frequent correlative glycogen studies were made on oysters from habitats under observation.

Results

As was expected, substantial variations in salinity were observed seasonally and weekly. The variations found intertidally and hourly were surprisingly large in certain cases.

In Figure 1, seasonal salinity variation (as standard deviation) and oyster

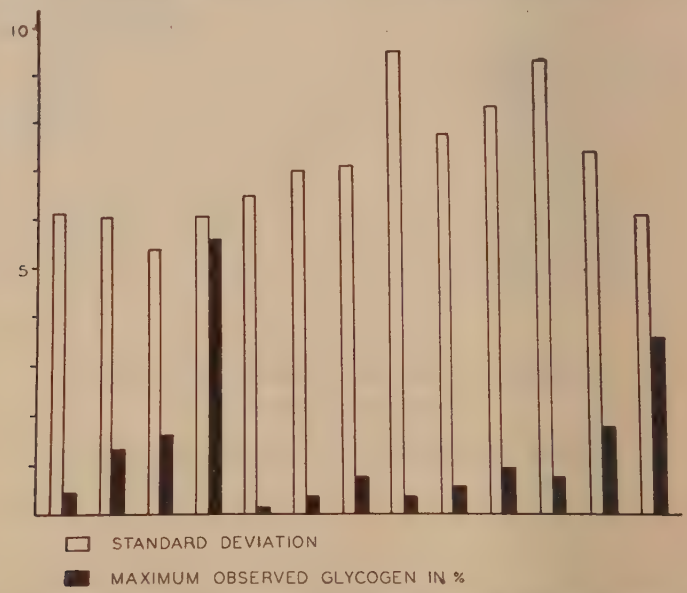

FIGURE 1—Seasonal salinity variation correlated with observed glycogen content. Stations from left to right are as follows: Cat Point, Porter's Bar, Green Point, Indian Pass, Goose Island, Pilot's Cove, East Slough, Paradise Flat, Cabbage Lump, St. Vincent's, Miller's 13 Mile, Nick's Hole, and Sebastian.

condition are shown together. Eighteen month ranges of salinity for various stations in Apalachicola Bay are shown in Figure 2, which is a haligraph modified after the suggestion of Stauber (1943). Maximum weekly ranges of salinity for all stations are indicated in Figure 3. In Figure 4, maximum ranges intertidally are provided.

Results of 24-hour studies are shown graphically in Figures 5 and 6 for Porter's Bar and St. Vincent's Reef, respectively.

A summary of all data gathered is presented in Table I.

Discussion

The oysters of Apalachicola Bay, from the standpoint of salinity variation, live in a rigorous habitat. During their development to marketable size they are

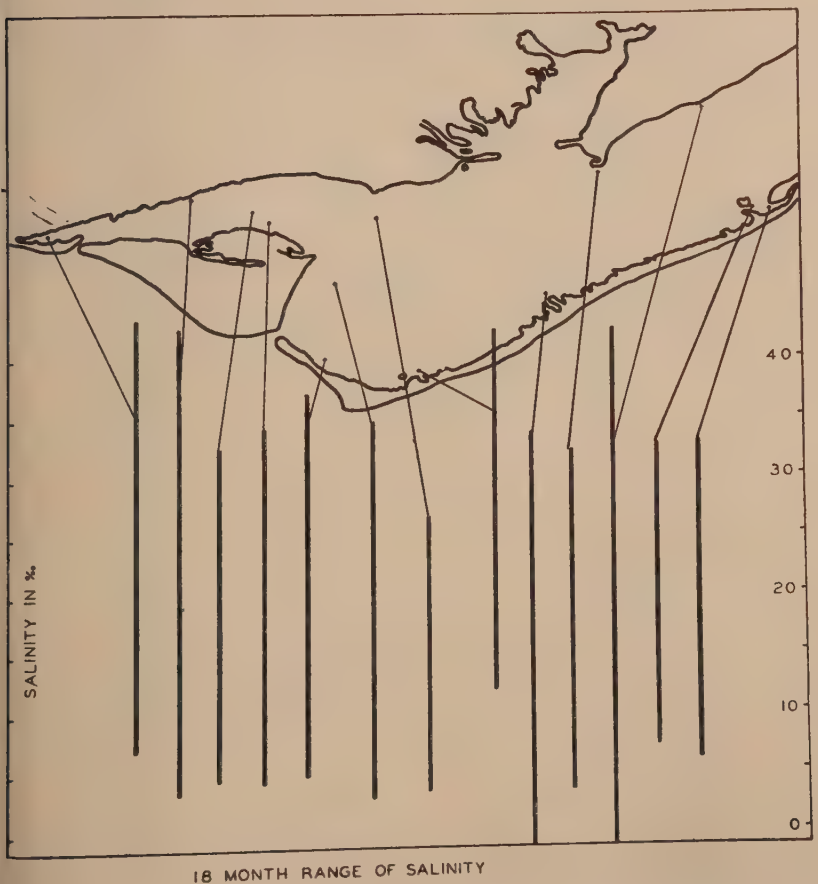

FIGURE 2—18 Month Range of Salinity. Stations from left to right are as follows: Indian Pass, Miller's 13 Mile, Paradise Flat, Cabbage Lump, Government Dock, St. Vincent's, Green Point, Pilot's Cove, Nick's Hole, Cat Point, Porter's Bar, Goose Island, and East Slough.

	18 MONTHS				INTERTIDAL			WEEKLY				
Station	*No. Obs.*	*Range*	*Standard Deviation*	*Ave. Sal.*	*No. Obs.*	*Greatest Range*	*Ave. Range*	*No. Obs.*	*Greatest Range*	*Ave. Range*	*Produc.*	*Highest Obs. Gly.*
Pilot's Cove	68	11.9—42.4	7.0	24.5				20	20.5—35.6	8.3	Small	0.3
Cat Point	144	0.0—32.1	6.2	15.6	10	8.0—23.0	4.8	61	0.0—22.2	7.1	Medium	0.4
Porter's Bar	158	0.0—42.5	6.1	19.8	9	9.2—13.1	1.9	56	15.4—42.5	7.7	Heavy	1.3
Green Point	57	3.2—26.5	5.4	14.2	6	16.0—21.4	3.8	13	13.6—26.5	5.7	Heavy	1.6
Indian Pass	143	16.1—43.8	6.1	27.2	11	25.0—33.3	3.1	54	10.7—35.0	5.9	Heavy	5.6
Paradise Flat	36	4.3—32.8	9.5	16.3	4	5.4— 7.0	0.8	7	5.4—27.4	10.6	Heavy	0.3
Cabbage Lump	77	4.3—34.5	7.7	16.3	9	13.1—30.0	4.8	17	9.9—33.0	11.0	Heavy	0.5
St. Vincent's	197	2.6—34.9	8.3	22.1	14	14.1—30.2	6.6	21	10.8—34.0	12.0	None	0.9
Miller's 13	113	3.3—43.8	9.4	20.6	5	5.0—22.7	6.7	49	3.5—33.7	10.2	None	0.7
Nick's Hole	83	0.0—33.6	7.3	17.5	2	7.2—15.6	6.9	20	0.0—20.3	7.4	Small	1.7
Goose Island	33	7.0—32.7	6.5	20.6				11	10.7—26.0	4.7	None	
East Slough	28	5.9—32.9	7.1	21.6				11	11.4—24.2	4.8	None	
Govt. Dock	49	4.8—42.8	7.4	22.2				37	16.7—42.8	9.2	None	

TABLE I

Summary of salinity observations taken daily, weekly, and tidally correlated with production estimate and maximum observed glycogen. Salinity figures refer to parts per thousand.

xposed to a range of salinity extending from fresh water, or nearly so, to ten r more parts per thousand more than is found in ocean water.

More frequent changes of salinity of substantial magnitude are endured. Tidally, variations of 8-10 parts per thousand are not uncommon. In one nstance (Cat Point) a variation of 15°/₀₀ was observed in an area of high roductivity.

Occasional weekly variations of approximately 25°/₀₀ do not seem to interfere vith the development to marketable size and quality. Indian Pass consistently nad the best oysters of the Bay during the winter of 1949-1950, yet the average veekly salinity change for that station was 5.9°/₀₀ (maximum 24.3°/₀₀).

A correlation between magnitude of salinity change per unit of time and oyster quality (based upon glycogen and production) does not give conclusive esults. Apparently, oysters in one habitat can stand a tidal variation of 10.6°/₀₀

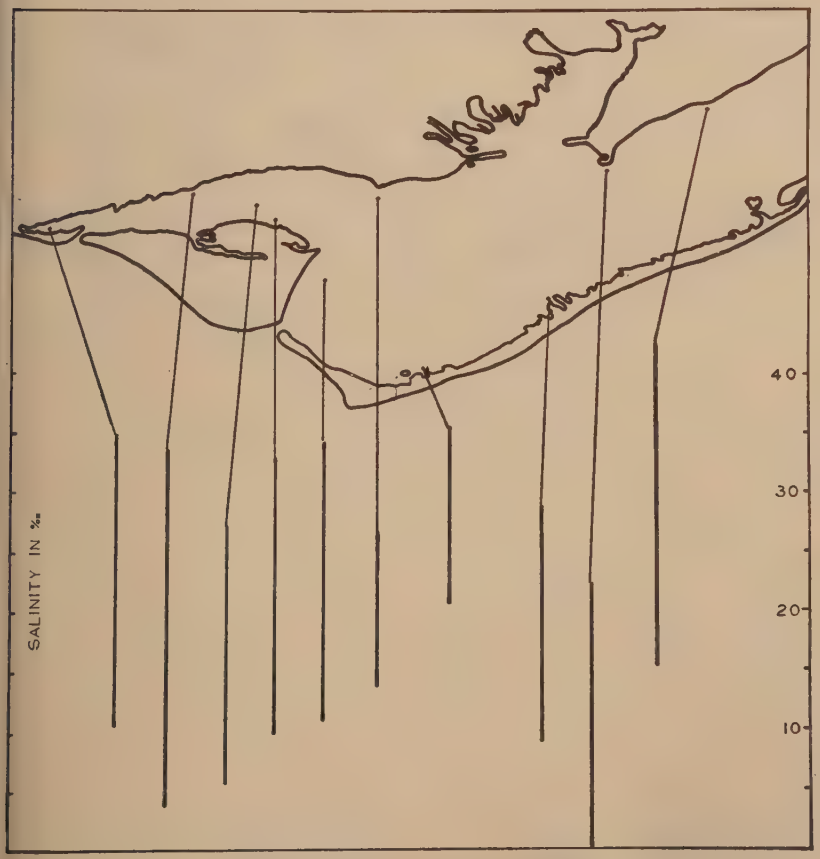

FIGURE 3—Maximum weekly salinity range. Stations from left to right are as follows: Indian Pass, Miller's 13 Mile, Paradise Flat, Cabbage Lump, St. Vincent's, Green Point, Pilot's Cove, Nick's Hole, Cat Point, and Porter's Bar.

as an average and still be of marketable quality (Indian Pass). This lack of correlation is also noticed in weekly and seasonal changes.

There is some reason for believing that range of salinity variation may be a more critical factor for oyster production in Florida than the high temperatures they experience. Fast growing, high quality (ave. gly. 3.5%) oysters are found consistently in commercial quantities 154 miles north of Miami in the Indian River. The daily temperature of the water in that area during December, 1949, January, and February of 1950, averaged 24.3° C. During the three month observation period, however, the change of salinity from day to day averaged only 1.7°/₀₀. There are no appreciable tides in the area.

It was observed that the quality of the Indian River oyster was the same during the entire winter. The quality of oysters from the best area of Apalachicola Bay did not remain constant during this period although the average

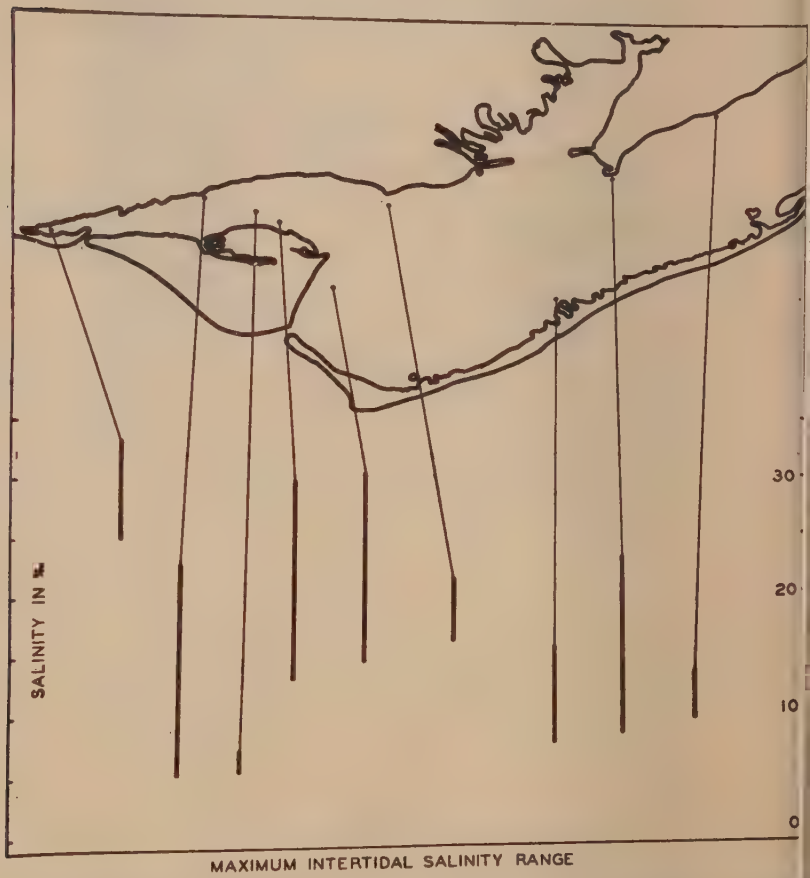

FIGURE 4—Maximum intertidal salinity range. Stations from left to right are as follow: Indian Pass, Miller's 13 Mile, Paradise Flat, Cabbage Lump, St. Vincent's, Green Poi Nick's Hole, Cat's Point, and Porter's Bar.

temperature was lower than that of the Indian River. The average water temperature during December, 1949, January, and February of 1950, was 18.9°C. for Apalachicola Bay. This figure is based upon 45 observations taken during that period at widely isolated parts of the estuary.

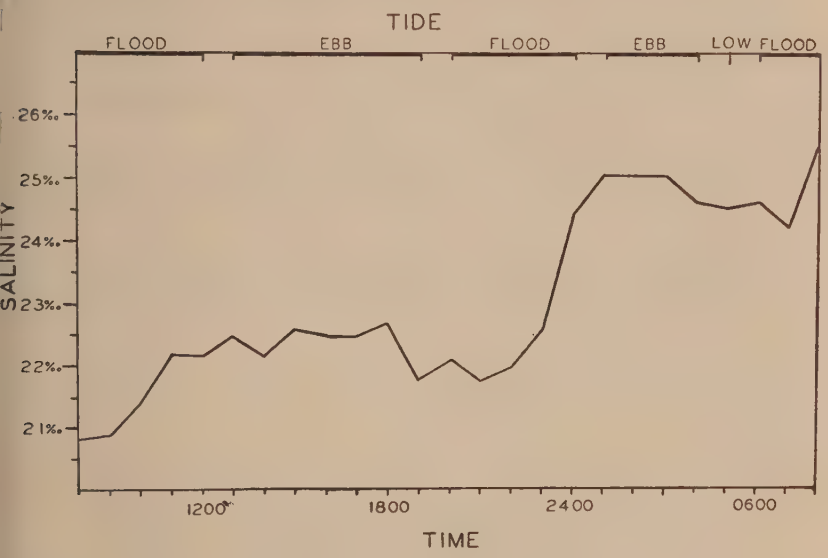

FIGURE 5—24 hour surface salinity observation at Porter's Bar.

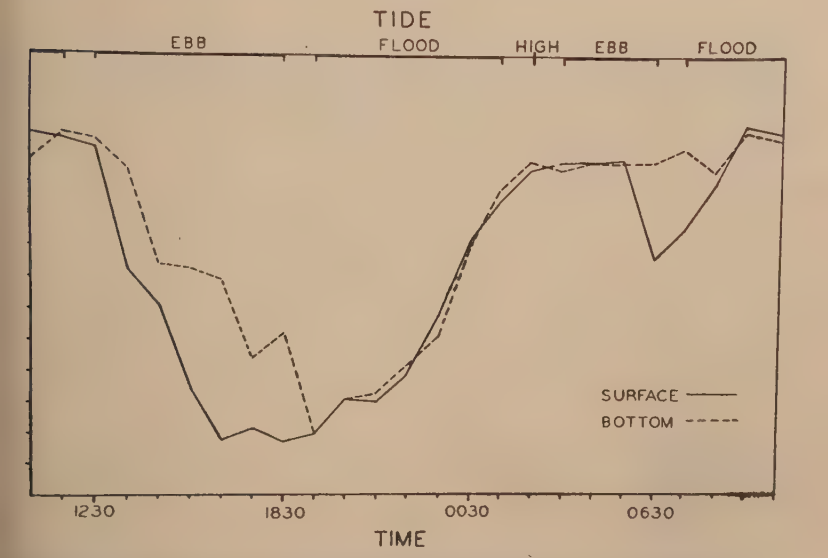

FIGURE 6—24 hour surface and bottom salinity observations at St. Vincent's Reef.

Summary

1. An eighteen month survey of salinity conditions has been made of Apalachicola Bay, present center of Florida's oyster industry.
2. Annual variations in salinity from fresh water to 42.5°/₀₀ are not only tolerated by the indigenous oysters, but commercial production is present where those conditions exist.
3. Marketable oysters in Apalachicola Bay are found in habitats which experience weekly salinity changes averaging 11°/₀₀.
4. Commercial production of oysters is possible in habitats showing an average tidal salinity variance of 4.8°/₀₀.
5. Growth rate studies carried on simultaneously with the salinity investigation indicate that growth under the salinity variations mentioned above is extremely rapid. One inch in length is achieved in five weeks, and 2.6 inches in 16 weeks.
6. In general, Apalachicola oysters are not of superior quality. It is suggested that the low glycogen content might be due to the great ranges of salinity to which they are exposed.

References

STAUBER, LESLIE A. 1943. *Graphic representation of salinity in a tidal estuary*. Sears Found. Journal Mar. Research 5:165-167.

The Species Of Oysters Of The Gulf, Caribbean And West Indian Region

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*Abstract

THERE ARE SPECIES of all three living genera of Ostreidae in the Gulf and West Indian region. They are *Pycnodonte thomasi, Ostrea cristata, O. frons, O. permollis, Crassostrea virginica and C. rhizophorae. O. limacella* seems to be synonym of *frons. O. spreta* is in part a synonym of *cristata.*

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Is The Natural Sponge Fishery Doomed By Synthetic Sponges?

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)URING THE LAST MEETING of the Gulf and Caribbean Fisheries Institute in lovember, 1949, several speakers emphasized methods for aiding the sponge ıdustry from the biological viewpoint. J. Q. Tierney and C. E. Dawson, of ıe Marine Laboratory, University of Miami, recommended sponge cultivation nd indicated culture methods. They suggested the establishment of a sponge arm for the purpose of providing stock for the depleted sponge beds, and ıe transplantation of healthy stock from other areas to the Tarpon Springs rounds. Dr. Lewis Radcliffe recommended the adoption of a sponge fishery ıanagement plan for Florida and the Bahamas, favoring the transplantation ·f high quality commercial sponges to Florida waters. Congressman Charles E. Bennett from Florida advocated the passage of S.2489, 81st Congress, first ession, a bill which was introduced by Senator Pepper and which would enable he Secretary of the Interior to carry out a program of research and experiment vith respect to natural sponges, to study the disease of natural sponges and to ›ropagate and plant natural sponges.

This paper is a further contribution to the subject, from the economic point of view, and reports the results of a survey which was undertaken during the summer of 1950. Questionnaires were sent to distributors of natural and synthetic sponges, requesting information on preferences and purchasing habits. There are 91,124 retail outlets in the United States engaged in selling sponges. Of these, 33,221 handle hardware and 57,903 are drugstores. The questionnaire, prepared by the Fish and Wildlife Service, was distributed to representative stores in these groups through the National Association of Retail Druggists and the National Retail Hardware Association, each of which sent out 400 copies at its own expense. Both the preparation of the questionnaire and the stratification of the samples were done by use of modern methods of opinion research and by applying rules of procedure established by experienced poll technicians. There were 206 answers received. This is a 25.7 per cent response; 20 per cent is judged to be sufficient to be representative. The answers obtained by the questionnaire have provided a valuable basis for the evaluation of certain factors in the marketing of sponges.

Thirty-three drugstores reported an average monthly sale of 280 sponges. These included 161 small, 83 medium and 36 large sponges. Since small sponges average about 25 to the pound, medium about 18 to the pound, and large sponges about 11 to the pound, the average sale of sponges for the 33 stores was 14.32 pounds per month. Of the drugstores reporting, 47.8 per cent sold natural sponges. From their sales was computed a yearly sale of about 145,000

pounds of natural sponges by all drugstores, for the year ending June 30, 1950

Sixty-five hardware stores, or 49.2 per cent of those answering, reported the sale of natural sponges. They sold a monthly average of 1,295 sponges, including 358 small, 544 medium and 393 large sponges, weighing 80.27 pounds. The total sales of the hardware stores were calculated to be about 212,000 pounds. Total sales of hardware and drugstores were about 357,000 pounds. These figures of sales agree closely with the amounts of sponges imported and produced domestically. In 1949 the United States imported 268,000 pounds of sponges and the Tarpon Springs Sponge Exchange sold about 84,000 pounds

QUANTITIES AND VALUES OF SPONGE RETAIL SALES IN U. S. IN YEAR ENDING JUNE 30, 1950

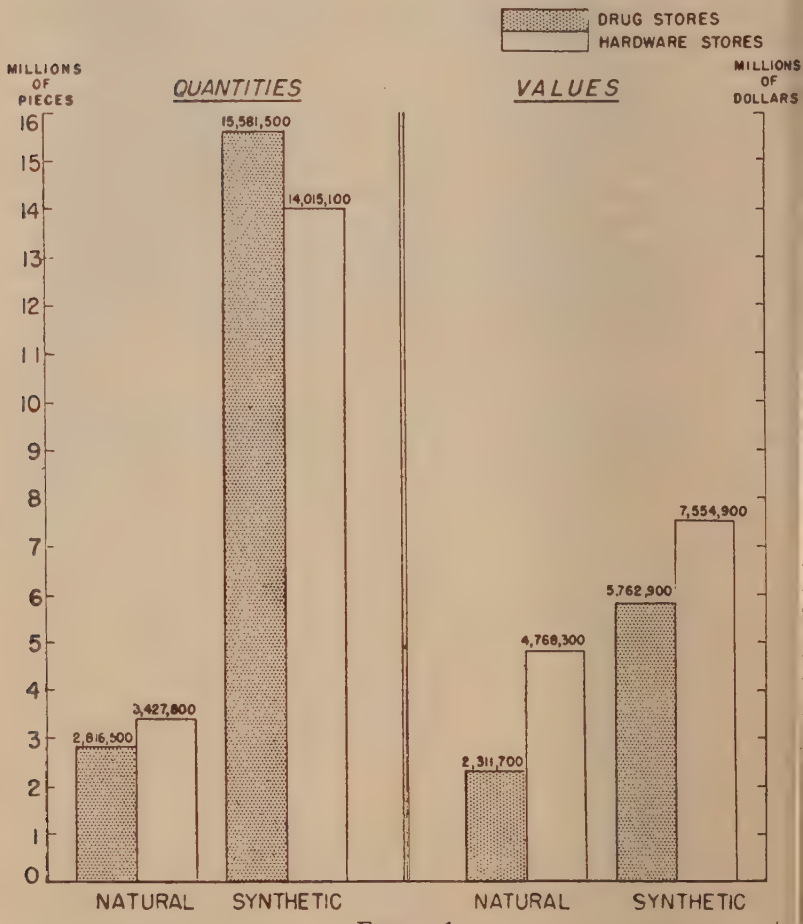

FIGURE 1

total of 352,000 pounds. Adding the few thousand pounds which were sold utside the Tarpon Springs Exchange, mostly at Key West, the figure is almost actly the same reported in the questionnaires and projected on an yearly basis. Drugstores sold about 2,816,500 pieces of natural sponges, hardware stores out 3,427,800 pieces, a total of 6,244,300 natural sponges. Thus hardware

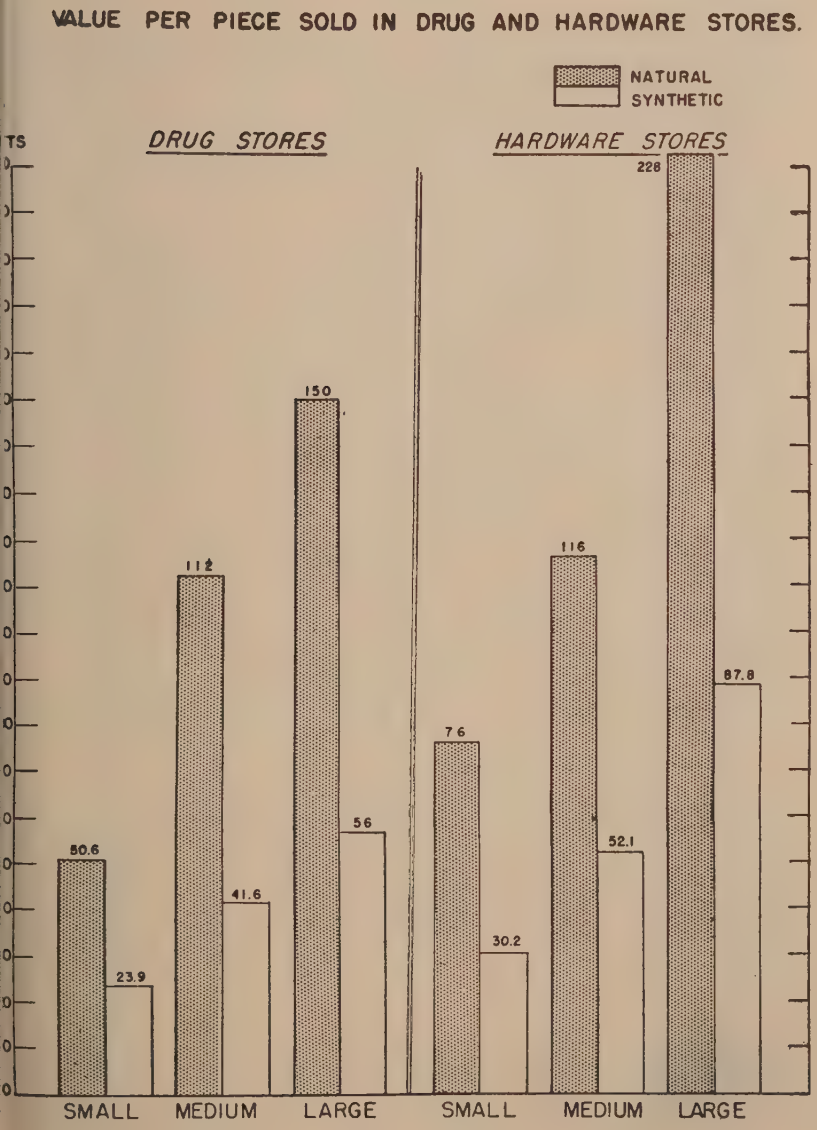

FIGURE 2

stores did 54.9 per cent of the business.[1] This quantity compares with abo 29,596,600 synthetic sponges sold, of which approximately 24,090,400 we cellulose sponges, about 4,877,700 were rubber sponges and about 628,500 we other synthetic sponges. Drugstores sold about 15,581,500 pieces of synthet sponges and hardware stores about 14,015,100 pieces. Thus, sales of synthet sponges at present surpass sales of natural sponges by 373 per cent in numbe of pieces.

It can be estimated[2] that the cellulose sponges sold in the period ending Jun 30, 1950, weighed about 1,515,300 pounds, the rubber sponges weighed abo 339,000 pounds, and the other synthetic sponges weighed about 46,200 pound The total weight of synthetic sponges was consequently estimated as bei about 1,900,700 pounds. The weight of the synthetic sponges sold surpass the weight of the natural sponges by 434 per cent, the average natural spong weighing .057 pounds, being lighter in weight than the average synthetic spon which weighs .064 pounds.

On a value basis, drugstores sold about $2,311,700[3] worth of natural spong and hardware stores sold about $4,768,300 worth. Total retail sales of natur sponges were about $7,080,000 during the year ending June 30, 1950. Th compares with sales of about $13, 317, 800 of synthetic sponges, of which abo $10,967,700 worth were cellulose sponges, about $1,959,000 worth we rubber sponges and $391,100 worth were other synthetic sponges. Hardwa stores sold about $7,554,900 worth of synthetic sponges. Sales of cellulo sponges by drugstores were valued at $4,396,000 (40.1 per cent) and by har ware stores to the amount of $6,571,500 (59.9 per cent). Rubber sponges sc in drugstores amounted to a total sales value of about $1,312,400 (67 per cen and in hardware stores to $646,600 (33 per cent). Other synthetic spong had minor importance in the drugstore sales, amounting to only $54,300 (12 per cent) and in hardware stores to about $336,900 (86.1 per cent) during t period involved. The average unit value of the natural sponges sold was $1.1 the unit value of synthetic sponges, 49.3 cents. While synthetic sponge sales su passed natural sponge sales by about 120 per cent with respect to total val sold, the unit value of the natural sponges was higher by 129 per cent.

Hardware stores transacted 67.3 per cent of the natural sponge business, y value, but only 55.2 per cent of the synthetic sponge business. The reason r this difference is explained below.

The questionnaire also produced information as to consumer preference r natural sponges. Some interesting results may be derived from the answe Question 12 asked: "Please give your opinion of the additional amount, if a consumers would pay for natural sponges as compared with synthetic sponge" It is notable that the majority of those who replied to the question did nt say that natural sponges must or should have an equal sales value with synthe sponges. Replies indicate that, in general, consumers would pay 25 per cnt

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1 Compare Figure 1

2 Weights of synthetic sponges used, based on factory reports were as follows: s all cellulose sponges ½ ounce (.031 lbs.) each; medium, 1 ounce (.0625 lbs.) each; nd large, .114 lbs. According to information received from the United States Ru er Company, rubber sponges weigh about 20 per cent more than cellulose sponges.

3 See Figure 2

more for natural sponges. Drugstore customers would pay around 50 per cent more. This indicates that in drugstores a better price can be expected for natural sponges than in hardware stores. This means a retail price of about 75 cents per piece would be most acceptable to consumers. This would involve a reduction of the present price level of natural sponges of about 30 per cent at the retail level. It should now be considered whether such a reduction is possible. This question is related to the possibility of rehabilitating the sponge beds. If the beds can be rehabilitated, a price reduction does not necessarily mean income reduction, since higher sales volumes could then be realized. If the rehabilitation of the sponge beds should succeed, an increase in the production to nearly prewar levels could give the fishermen a better income than they have at present, even with reduced prices. In 1949 the average price received by the fishermen through the Tarpon Springs Sponge Exchange was $5.61 per pound. Total sales at Tarpon Springs, however, were only 83,947 pounds. If sales increased to prewar highs of about 600,000 pounds, the income of the fishermen in the Tarpon Springs area would be about $3,000,000, or even if the increase were only to the half of the prewar production, their income would be $1,500,000 compared with the $471,000 they received in 1949. Such increases in production would probably bring about adjustment of unit prices so that the market could be expected to absorb them.

Other considerations which are important for the recovery of the sponge industry should be considered. Improved marketing is one of these. Good marketing means that a product be brought before the consumer in a state which as nearly as possible fills the needs of the consumer without further handling. It is also necessary to invite the consumer's attention through proper sales appeal when the product is offered. It is further necessary to make the consumer aware of the availability of the product and its advantages in different possible uses through proper advertising. Finally, every level of distribution has to see to it that the product is available to the public at any time it is needed and in the proper assortments and proper price classes. These are four fundamental marketing principles. All were emphasized by the results of this survey and they indicate that improvements can be made in the marketing of natural sponges. Question 10 of the questionnaire asked, "What factors would increase the sale of natural sponges?" Besides "lower prices" the greatest number of opinions recommended "better grading." This means, in the case of natural sponges, that not only should small, medium and large sizes be properly separated, but also that the sponges should be sorted better as to quality. One opinion referred specifically to the fact that sometimes sand and stony material are found in sponges which have to be washed out before they can be used.

The second greatest number of opinions referred to "improved packaging." It is known that the synthetic sponge industry conquered a great portion of its territory by wrapping its product in transparent paper which gives a better appearance and acts as a purchasing incentive. Some dealers indicated that they cut natural sponges and pack them in transparent paper in order to meet the competition of the synthetic sponges. Improved packaging should become a common practice and it should start at the first distribution level.

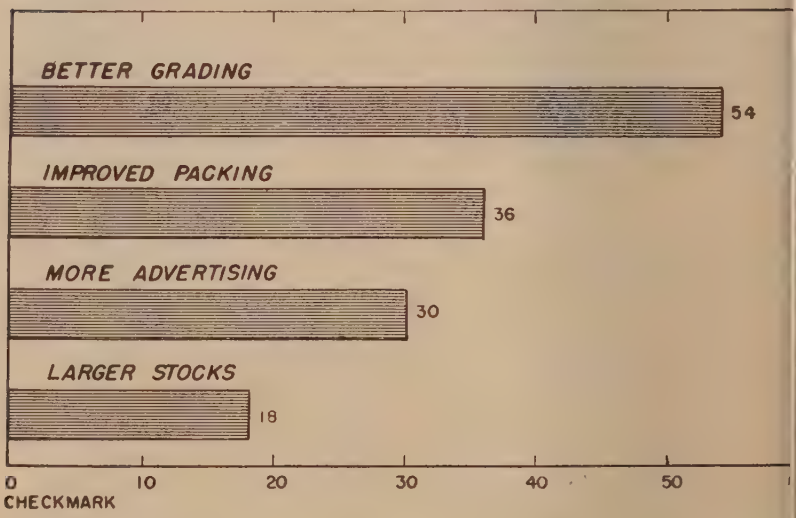
The third greatest number of opinions referred to "more advertising" as a medium of increasing the sale of natural sponges. The only advertising or publicity for natural sponges appearing in newspapers at present is in connection with hurricanes or disasters which come over the sponge fishing industry. Rarely

is there an article on the usage of natural sponges, on their properties, or o sponge fishing.

The fourth largest number of opinions expressed in connection with Ques tion 10 refers to "larger stocks." Some merchants cannot always obtain th sponges they had ordered or they cannot obtain the sponges quickly enoug to comply with the needs of the consumer. Of the opinions received, 6 pe cent referred to this point. This means that about 3,600 retail stores could no obtain natural sponges either within the desired grades or within the desire period of time. Wholesalers as well as distributors must maintain larger stock from which to fill the needs of the retailer if they want to improve the sale o natural sponges.

The answers received to Question 10 agreed with the answers to Question in which it was asked, "If synthetic sponges have become more popular, wha is the reason or reasons?" Besides the replies that "prices are lower" othe factors were mentioned, such as, "more on hand," or "greater selections," whic shows that the question of availability plays an important part in this trade Other respondents mentioned "more uses," or "better quality" as the reason fo the popularity of synthetic sponges. However, these two answers should per haps be regarded with skepticism because Question 11 asked about the com parative value for the various uses of natural and synthetic sponges and re ceived answers which show that the number of consumers preferring natura

RECOMMENDATION AS TO METHODS OF INCREASING NATURAL SPONGE SALES. (BESIDES LOWERING PRICES AND SOME NEGLIGIBLE REASONS.)



X ON THE BASIS OF 283 CHECKMARKS, OF WHICH 132 REFER TO "LOWER PRICE".

FIGURE 3

sponges was about equal to those preferring synthetic sponges. It is apparent from this survey that the consumers of natural sponges are more enthusiastic about the products of their selection than the consumers of synthetic sponges. The questionnaire gave evidence of the attitude toward natural and synthetic sponges and the suggestions for increased sales of natural sponges. (Figure 3.)

Four varying opinions are quoted.

1. Natural sponges are softer but synthetic sponges are more durable and absorbent. In dust respirators, which require a fine-textured, soft sponge, the natural sponge seems to be superior.
2. A select unbleached natural sponge will out-perform and outlast synthetic sponge, but preparation, selection, packaging, and price of natural sponges have reduced their consumption. It is not uncommon to find shell particles and sand in even the best of natural sponges.
3. Natural wool sponges are softer and more durable. It was suggested that manufactures could improve wool sponges by the addition of a little wintergreen in the final treatment to reduce the odor.
4. Natural sponges are very superior for every use. Some respondents believe they would far outsell synthetic type of sponges if prices were lower, if better graded and packaged.

The principal use of natural sponges is for car washing and for cellulose sponges is "housewife's general use." Of second importance for both types is for window cleaning. For cellulose sponges separately, the third most important use is for car washing, and for natural sponges the third most important use is "housewife's general use."

Summarizing the results of the questionnaire and interpreting them in the light of the general economic situation, the conclusion is drawn that the natural sponge industry will be able to recover lost ground if the *sponge beds are rehabilitated* so that production is increased to about 300,000 pounds per year and if prices recede as a result of this increased production. This still can, and should, leave a greater income for the fisherman. Recent economic developments have made the prospects for the development of the natural sponge industry appear more favorable. These recent developments center around the Defense Production Act of 1950 and the necessity arising under this Act for manufacturers of synthetic sponges to give priority to certain defense orders. The National Production Administration already put a restriction on the use of rubber for civilian purposes (M2 NPA) which will cut the quarterly rubber sponge production by about 15 per cent below the production during the period July-September 1950. No formal order of the National Production Administration has been issued concerning cellulose sponges, but it is known that the main producers of cellulose sponges are voluntarily allocating raw material which means a 15 per cent to 25 per cent reduction of the incoming civilian orders. This gap between production and demand, which probably will increase with the constantly increasing number of automobiles operated, can be filled by the natural sponge industry, if the conditions are met which this paper describes.

The Development Of The Brown Shrimp Fishery In Texas

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New Orleans, Louisiana

THE SHRIMP of the southern United States are among our most valuable marine resources. The present production of this crustacean exceeds one quarter of a billion pounds, of which the Gulf of Mexico produces more than 75 per cent. The growth of the fishery in the past five years has been attributable chiefly to the exploration of the grooved shrimps, *Penaeus aztecus* and *P. duorarum*. The phenomenal growth of the fishery has been greatest since 1945 for prior to the beginning of the brown shrimp fishery in Texas, Lindner Anderson, and Johnson of the Bureau of Fisheries estimated the catch of grooved shrimp to be about 3 per cent of the total annual shrimp harvest.

Several circumstances contributed to the growth of the brown shrimp fishery in Texas. In 1940 there were less than 70 trawlers, of 5 net tons or greater, operating in Texas. In the same year the vessel *Neptune* brought the first cargo of grooved shrimp to Port Isabel, near Brownsville, Texas. The catch amounted to 3400 pounds and was taken on East Bank near Port Isabel. The "brownies" were marketed, but at reduced prices compared to those for common shrimp. The catch of the *Neptune* is the first known case of an entire load of brown shrimp being landed and marketed in Texas. Apparently the significance of this catch was not immediately recognized, for there is no further record of landings of this variety until much later, excepting the few sold with the common shrimp. The war years cut short field observations, and only hear say evidence exists from 1941 to 1945. However, the construction of new trawlers did not halt, since higher prices lured fishermen and wholesalers to construct more and larger trawlers. These vessels were, for the most part, 4 to 50 feet in length and the owners were in many instances indebted for sum amounting to 11 to 16 thousand dollars. Shortly after the war there develope off Carmen, Mexico, a fishery for the white shrimp, and it was this operatio that drew off many boats from the Texas and Louisiana coasts. With the pres sure reduced, building continued and by the summer of 1947 large numbers c trawlers had returned from Mexican waters and established themselves in Texa By this time costs had risen and many new owners found themselves burdene with a heavy investment in a declining white shrimp fishery. It was this ver serious economic condition that faced the Texas shrimp fishery in the summe of 1947. Many of the owners, not content to remain in port and lose the investment, took to sea in search of a money crop. That year, 1947, marke the turning point of the fishery, for landings of brownies at Aransas Pass wer greater than ever before, many cargoes being totally brown shrimp. The shrimp did not sell very well at first, and dealers refused to buy some catche Others took the lead in attempting to market the catch of brownies. Son progress was made, and 1948 saw increased landings of brown shrimp a along the Gulf coast. This expanding market provided momentum for th expanding fleet and new boats were added each month. These were of a larg more seaworthy type, of increased cost. Some dealers further restricted brow shrimp landings in 1948, which forced some trawlers to tie up; others on worked harder.

The Fish and Wildlife Service tagged shrimp along the Texas coast, a

proved that shrimp from Texas migrated along the Texas coast toward Mexico, showing that these animals had little regard for man's artificial boundaries. Fishermen, observing these operations, reached their own conclusions: that schools of shrimp at Carmen, Mexico could be intercepted by fishing the Texas coast south of Aransas Pass to the Mexican border. This they did, and since the fishing was outside the territorial waters of the state, the trawlers did not stop because of darkness as they are obliged to do in waters within the jurisdiction of the state. It was in the hours of darkness that the largest catches were made in early April of 1949. It should perhaps be pointed out that, had not several trawlers operated together in the same general area, the brownies might never have been taken, for it seems that when this variety is sought by trawlers fishing one behind the other, the first craft may expect a smaller catch than the following boats.

Another contribution to the development of this fishery was the use of echo sounding devices. Much of the fishing off Brownsville area is in mud gullies between rock formations. Net losses were relatively high. Since most of the shrimp were taken in water ranging from 20-27 fathoms in depth, the echo sounding devices were of great value in increasing the catch per unit of effort by keeping the craft in the gullies of correct depth. The initial influx of boats was to Brownsville simply because of lack of harbor facilities in other nearby ports. One firm handled all the unloading for several months, but as the permanency of the fishery was demonstrated other houses were constructed. A very substantial portion of the catch was landed with the heads off and therefore required little labor at the wharf. The catch was either frozen after being landed or was trucked up the coast to Port Lavaca or Galveston. Probably little of the early catches were marketed fresh.

Market resistance was overcome to some extent by lowering the price and by intensive advertising. The shrimp were given such names as "Golden Browns" and "Golden Brazilians." Several articles were written by specialists of the Fish and Wildlife Service informing the public of the quality of brown shrimp. Trade magazines assisted with editorials, comments and opinions. All these factors helped to lessen buyer resistance to this valuable fishery. It should not be overlooked that at this time there was a strong market demand for shrimp. Had this fishery been discovered ten or more years ago, it probably would not have been exploited, simply because the product would not have had a market. It might be noted in this regard that brown shrimp had been taken in Louisiana for many years, but no attempt had been made to expand the fishery simply because of the limited extent of the market. Fortunately the Brownsville fishery was discovered at a time when the market could be taught to accept the product.

The Brownsville fishery is now over a year old and by continued exploration the extent of the fishery has expanded to include areas near the Campeche Banks of Mexico. Landings were originally only of *Penaeus aztecus;* they now include *P. aztecus, P. duorarum,* and *P. setiferus.* Production has now increased until Texas lands over 50 million pounds of shrimp annually.

In summary, the most important factors contributing to the development of the brown shrimp fishery have been (1) market acceptance of the brown shrimp, hitherto considered unacceptable (2) construction of larger and more expensive trawlers, making necessary more shrimping grounds (3) attempts to intercept schools of white shrimp believed moving south to the area off Carmen, Mexico and (4) use of sounding instruments to fish areas formerly unavailable to commercial trawling.

International Aspects Of The Shrimp Fishery In The Gulf Of Mexico

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Abstract

The department of State is concerned only with conservation in internationa waters and the rights of our fishermen. There are no conservation problems i the Gulf and the fishermen's rights question is quiet at present. The Departmen of State abides by the international three mile limit.

Potentialities For Increased Utilization Of Scrap Fish And Fish Waste In The Gulf And Caribbean Area

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In the Gulf and Caribbean areas large quantities of scrap fish and fish wast are discarded annually. Shrimp fishing is responsible for a large portion of th wasted by-product and the quantity of shrimp taken in this area is increasin annually. In Texas it is reported that the production of shrimp has more tha doubled during the last two years and is steadily increasing. Off the souther coast of Florida a tremendous new shrimping area was uncovered this pa year and further investigation indicates that large beds exist all along the Gu Coast that will be fished in increasing volume within the next few years.

About 40 per cent of the total weight of shrimp is in the "head." Heads a usually removed at sea and dumped overboard. When shrimp are peeled f canning there is an additional 10 per cent waste. Therefore, at the cannir plant 50 per cent of the weight of the shrimp that are caught is discarde Coupled with this is a large amount of trash fish that is unavoidably caught the shrimp trawls. As much as 90 per cent of the haul is frequently trash fi that must be separated out and thrown overboard. In the newly-discover Florida beds some fishermen have reported that at no time are they able bring up enough edible fish even to supply the crew. The trash fish seem to l almost entirely of the inedible type, and therefore should be ideal for processi into feed.

An estimate made by the Texas Game, Fish and Oyster Commission La oratory at Rockport, Texas on the basis of a short series of drags, reveal that only 7 per cent of the total weight taken was actually marketed. O night of dragging by the research ship *Oregon*, with relatively good fishin produced 2870 pounds of heads-on shrimp and marketable fish and 42 pounds of unmarketable fish and invertebrates. The amount of scrap tends be highest from the small in-shore boats, and since this area generally pr duces the smaller shrimp the amount of work in separation of the catch greater. Most of the surveys on scrap ratio seem to have been based on i shore operations. However, as stated above, it is reported that in the new discovered deep-water beds off the coast of Florida, a tremendous quantity trash fish is being brought in at each haul, and that the catch of trash fish o these beds will run frequently close to 90 per cent.

The U. S. Fish and Wildlife Service reports the following catches of shrimp along the U. S. Gulf Coast for the year 1949. This report is given in barrels of 210 pounds of shrimp with heads on which normally would be the equivalent of 125 pounds of shrimp with heads off.

Florida (being mostly the Apalachicola area)	5,738 barrels
Alabama	9,179 barrels
Mississippi	20,334 barrels
Louisiana (New Orleans area)	20,573 barrels
Louisiana (Golden Meadow area)	9,554 barrels
Louisiana (Houma area)	29,631 barrels
Louisiana (Morgan City area)	22,097 barrels
Texas (Galveston area)	25,562 barrels
Texas (Port Lavaca area)	14,000 barrels
Texas (Aransas Pass & Rockport)	20,000 barrels
Texas (Portersville & Brownsville area)	52,000 barrels

This is a total for Louisiana of 91,855 barrels, for Texas 112,240 barrels and a grand total for the U. S. Gulf Coast of 239,346 barrels. Computed at 210 pounds per barrel this amounts to 50,262,000 pounds of shrimp.

As stated before, of this amount fully 40 per cent can be calculated to be waste, or approximately 20,000,000 pounds. If the trash fish caught with the shrimp were saved, the amount of trash fish from this catch alone would amount to something like 502,000,000 pounds. Let us say that it would be practical to save only half of this amount. There would then be something like 250,000,000 pounds of trash fish that could be landed along with these shrimp. Adding to this the 20,000,000 pounds of heads normally wasted, there are 270,000,000 pounds of material available for processing.

Another product that has received only casual consideration is crab waste. Blue crabs are usually caught for processing rather than for the fresh market. These crabs are brought into a central processing plant, cooked, and the crab meat picked out by hand. Only about 15 pounds of crab meat is recovered from each 100 pounds of crabs caught. The remaining 85 per cent is dumped as waste.

The U. S. Fish and Wildlife Service reports the following catches of hard shell crabs along the Gulf area for the year 1949:

Florida	1,000.000 lbs.
Alabama	687,000 lbs.
Mississippi	783,000 lbs.
New Orleans area	4,000,000 lbs.
Morgan City area	2,915,000 lbs.

In Texas there appears to be very little crab fishing. Their report shows only 440 pounds for the year. The total, however, for the entire Gulf area was 9,434,280 pounds. This would result in 8,000,000 pounds of waste.

There is a considerable quantity of fish offal at various places along the Gulf, resulting from the processing of fresh food fish. This fish scrap and the crab waste, however, are usually at scattered points and in such small quantities at each point that it would not be practical to try to dry the waste at each individual fishing plant. However, a cooperative central drying plant could be built, convenient to each area, and the operation could then be made profitable.

The wastes from trash fish, fish offal, shrimp and crab operations are all easily processed, but are also easily damaged during processing, if the equip-

ment used is not properly adapted to the job. These by-products when properly handled make excellent feed for poultry and hogs and are a source of vitamin B. Hogs fed on crab waste that has been properly dried do not develop a fishy flavor in the meat that occurs if the crab waste is fed in the wet state. Dogs also relish these dried meals, and an excellent dog food can be made with any or all of these materials as a major base. Most of the product, however, has been sold for poultry feeding since there is a ready demand from this source.

It usually requires about 3 to 3½ pounds of crab waste to produce one pound of crab meal, about 4 to 1 for trash fish and 5 to 1 for shrimp heads. On this basis there is a possible 67,500,000 pounds of high grade fish meal and shrimp bran and 2,670,000 pounds of crab meal available along the Gulf Coast. These figures are based on the dried finished product ready for the feed trade.

To convert this waste into a salable product, it is first necessary to get the waste to the drying plant with as little cost as possible, as this can become an item of substantial cost unless properly managed. Since the shrimp boats are carrying edible cargo for human consumption it would be impractical to hold shrimp heads and trash fish on the boat for any length of time without icing. One practical means to overcome this problem would be to have a run boat to pick up the heads and trash fish from the shrimp fleet at regular intervals during the day. Trash fish and shrimp heads could be carried in special containers so that they could be transferred from the shrimp trawl boat to the pick-up boat by boom to facilitate handling in rough water. Another method would be to equip the boats with mechanical refrigeration, reserving one hold for the trash fish and shrimp heads and another hold for the headed shrimp. Actually, however, it would not be too costly to provide special boxes containing ice into which the trash fish and shrimp could be thrown in order to keep them until the shrimp boat arrives at its home port. This would be no more costly than would be the case if the shrimp were not headed at sea and were brought in to a canning plant.

Having succeeded in collecting the scrap at the plant, however, it is very easy to spoil everything and get little or no return from the drying operation. For instance, in the processing of shrimp heads the dehydrator must be constructed to provide a rapid flow of comparatively warm air to carry off moisture, without raising the temperature of the waste sufficient to damage the material. Shrimp heads are composed of a very thin oily shell that is easily dried before the wet solids of the head become dry, and can actually burn in a dryer that requires high temperatures. Feeding tests indicate that the vitamin B content of fish products is adversely affected at temperatures in the material above 180°F. The vitamin B content of the trash fish can therefore be easily destroyed by over-heating.

Further, trash fish, shrimp heads and crab waste should be cooked prior to dehydrating, and then ground before they are introduced into the dryer. In this cooked and ground condition the mass is somewhat sticky and very wet and tends to adhere to the metal surfaces in the dryer. Here it can build up into large lumps, harden and resist any practical attempts at uniform drying. It would not be practical to press this waste because a good part of the feeding value, particularly vitamin B, is in the dissolved solids. Therefore, it is most advantageous to dry all the moisture out of the waste, leaving all of the original solids in the finished feed. There has been developed a unique recyc

system connected with a triple pass dryer that solves this problem. This involves drawing from the dryer some of the partially dried material to blot up the surface free liquid, so that the resulting re-mixed mass is of a damp rather than wet nature. It is something like press cake that has gone through a standard fish press. In this condition the mass does not stick to the surfaces of the dryer and can be easily reduced to a uniform dried meal.

In processing this waste, the biggest individual item of cost is that of fuel oil for evaporating moisture. Further, the item of labor can be excessive if the plant is not properly designed, so that a continuous flow of the product from raw material to the sack is accomplished by means of proper control instruments. With such a plant labor costs become inconsequential. An example of the production costs for such an operation is as follows—

Fuel oil—50 gallons per finished ton of meal at 8 cents per gallon	$ 4.00
Labor—2 operators	4.00
Power—at 2 cents per Kilowatt hour	1.50
Steam	.60
Bags	2.50
Amortization of equipment, insurance and incidentals such as repairs, etc.	5.00
Total cost for producing meal	$17.60 per ton

The present market value of fish meal is about $125.00 per ton, for shrimp bran $100.00 per ton, for crab meal $60.00 per ton. We can therefore figure a fair net profit of $90.00 per ton for fish meal and shrimp bran, and $40.00 per ton for crab meal. Since the potential annual production of these meals is something like 35,000 tons, more than $3,000,000 of real profits are actually going to waste in the Gulf area each year. If arrangements were made to handle and market this waste, the fishermen would become interested in saving the trash and inedible fish, and would actually fish for them. In that case this tonnage and possible profit could easily be doubled.

Report On The Fisheries Of Surinam

PHILIP VAN GELDEREN
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THE DUTCH ACQUIRED SURINAM, or Dutch Guiana, as it is better known in this country, in an exchange deal with the British in the middle of the Seventeenth Century, whereby the Dutch ceded Manhattan to the British. Surinam is a tropical country of about 50,000 square miles, or, about the area of Wisconsin, with a population of approximately 210,000. Of this population, 70,000 live in the capital, Paramaribo. It has one of the most mixed populations in the world, consisting of Creoles of African-Dutch and Spanish extraction, of Indians, Javanese, Chinese, Bush negroes, and approximately 2000 whites. It is bounded on the South by Brazil, on the North by the Atlantic Ocean, on the East by French Guiana, and on the West by British Guiana.

During the years 1750-1755 Surinam was a wealthy country. There were about 500 plantations, producing sugar, coffee, cotton, and cocoa. At that time the general value of exports approached 265 million guilders annually. By

contrast exports in 1948 were valued at only 27½ million guilders. ($1 American is equal to about 1.90 guilders.)

Besides the bauxite mines at Moengo, well known in the USA, Surinam has important rice farming, citrus growing, and some goldmining and lumbering, as well as a number of industries, of which the manufacturing of leather and plywood form a fairly important element. Agriculture is mostly carried on by Hindustanis and Javanese. In Surinam there is one railroad, running from Paramaribo to the south, a distance of approximately 100 miles. The chief means of transportation is by way of the large inland rivers.

At present the fishing industry of Surinam is far behind the times. Fishing is mainly confined to inland waters. Not more than 800 families are engaged in this industry, and the catch does not exceed 2 million pounds per year. The main centers from which the fishing takes place are Paramaribo, Nickeri, and Coroni. Ocean fishing around Surinam is still in an embryonic state. It is carried on by small wooden vessels, which fish banks only a few miles from the coast off Paramaribo. Trawl fishing has not yet been tried.

The inland fishing is of much more importance than ocean fishing in Surinam. The fresh waters contain a wealth of fish, and there seems to be considerable room for expansion of the industry.

Three types of fishing gear are used: first a so-called pin-seine, for the fishing on the mudbanks, secondly a seine and bow net for fishing on the rivers, thirdly a bag net is used for fishing in the mouths of the rivers. Here shrimp are the main catch. In addition, long line fishing is practiced on a small scale.

As a result of the increase of the lumber industries, several reaches of the rivers can no longer be used for fishing, because pieces of lumber, which have sunk to the bottom, cause damage to the nets. River fishing is also complicated by the strong currents. As it becomes more and more difficult to fish in the rivers, the problems of finding new fishing grounds arises. Lacking familiarity with these new fishing grounds, there is reason to believe that the fishermen in these areas are not working in the most economic and efficient manner. In the inland waters fishing is done by small rowboats, not only on the rivers, but also around the flooded plantations. There existed at one time a large number of cotton and other plantations that have fallen into decay because of the migration of the population from the country to the cities. As a result these areas returned to their original state. The former locks that served to control the waterlevel deteriorated, and the areas became inundated by the rise of the tidal rivers. In one such area, of about 25,000 acres, 33 fishermen were recently operating.

In such areas, which are essentially large fish ponds, the fishermen catch enough fish to supply the population of Surinam. Most of these fish are herbivorous and are highly prized by the population.

To increase the productivity of fish in these flooded plantations, cultivation methods are being adopted. The ponds are to be divided into plots, which will be drained independently of each other. A test pond, measuring about 12 acres, will be used to carry out investigations on the spawning and growth of the fish. This inland fishery is important to the general welfare of Surinam.

The Bush negroes still fish with bow and arrow, with lines, and with a poison called "nicou." The poison stupefies the fish and allows them to be caught easily. A few Bush negroes have also learned the use of fish traps from the Indians.

What is the reason that ocean fishing has not developed more in a country situated on the Atlantic Ocean? It is partly because very few people live there. Java, which is only a little larger than Surinam, has 40,000,000 inhabitants, whereas Surinam has only 210,000. As long as the most modest demands of the population for fish could be met, there was no need for more intensive fishing. The standard of living in this tropical country is not high, and the diet of the people is deficient in proteins. A larger catch of fish is probably possible. At least 45 pounds of fish per annum per capita is necessary for minimum nutritional standards. Consumption in 1950, however, was only 32 pounds per capita, and 20 pounds of this quantity consisted of imported salted, dried, and preserved fish. This means that only 12 pounds per capita has been produced by the Surinam fishery. If this quantity has to be raised to 40 pounds per annum, then the catch will have to be increased by 2,000,000 pounds of fish.

At present there are too few fishermen to develop the fishing industry to this extent. Fishermen have organized themselves recently, but there are no fishery schools as yet. Though qualified authorities in Surinam give advice in the making of nets, and the use of fishery material in general, it cannot be said that there is enough skilled labor available to man the ships that are necessary to enlarge the fishing industry.

The fisheries of the countries near Surinam are rather backward too, though better in British Guiana than in French Guiana. These three countries share the same difficulties.

Such is the rather poor situation of the Surinam fishing industry. To improve this situation the Government of Surinam has instituted a research program that is being conducted by the Service for the Fishery Industry of the Department of Agriculture. This Service has at its disposal some very able experts in the fishing field. Among other things they have to investigate the migration of the fish and its frequency, and, in particular, the places where the fish spawn.

The Netherlands Government has not failed to help Surinam to develop her economy. The Netherlands has founded a Welfare Fund of 40 million guilders. Part of this money will be used for the development of the fishing industry. One of the tasks of the Fishery Service is to try out new methods that can be applied successfully in the unexplored fishing grounds. To this end a special vessel is being sent from Holland to Surinam, which is to be used for research work on the rivers as well as on the Atlantic Ocean. This ship has been fitted out in the most modern way, and is provided, among other things, with an echo-sounder. Research work will concern different species of fish, plankton, degree of salinity of the water, etc.

In Surinam efforts are being made to build a new fish market. Much has still to be done about the hygienic handling of fish. The present small supplies are sold on the general market, where vegetables, meats and other foods are sold as well. Though there is a cold storage warehouse in Paramaribo, where all kinds of foodstuffs are stored, this warehouse does not meet the requirements of modern methods of freezing and storing. There are plans for the construction of a well-equipped cold storage warehouse in Paramaribo, partly to be paid for out of the Welfare Fund.

There is also much interest for the processing of waste material into other products. Previously offal was discarded, but now a rather important industry for processing this waste material is growing up. There is a concern planning

to occupy itself with the handling of raw shrimp. At present the fishermen take care of their own catch of shrimp, which are boiled or fried after they get ashore. These shrimp cannot be kept for a long period of time. Probably in the near future shrimp will be taken directly from the place where they are caught to a mothership, to be processed there.

The U.S.A. is very much interested in the execution of Point 4 of the Program of the President. Surinam is in need of technical assistance which Point 4 offers. Surinam has a small population, little industry, and in consequence scanty means. The food supply could be considerably augmented by bringing fish to the market in greater quantities, at prices which the public can pay. This would improve living conditions substantially.

As long as it is scientifically undetermined to what extent the fishing industry can be extended, one cannot speak about "underdevelopment" as far as the fishery is concerned.

As soon as it is known that there *are* possibilities, sufficient capital and labor will have to be furnished to exploit them. It is believed that important improvements could be made in the fishery situation in Surinam by establishing fishery societies that would, among other things, concern themselves with the granting of loans for fishing material, and the organizing of auctions.

The construction of a cannery and fish meal factory is indispensable for the development of the fishing industry. Within the next few years the fishery in and around Surinam will probably be expanded considerably. Surinam is now in a transition period. Undoubtedly there is good reason to expect a great future for this country.

Some Economic Aspects Of Charter Boat Fishing In The Miami Area *

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THE PURPOSE OF THIS STUDY was to determine the extent of charter boat fishing in the Miami area, and to assign an economic value to the activity. Two questions were asked: (1) Is charter boat fishing a profitable business? (2) Of what value is charter boat fishing to the economy of the Miami area?

The information used to make the estimates in this study was gathered in many ways. Some of it represents interviews with the charterboatmen themselves, some was derived through consultation with the employees of the Cities of Miami and Miami Beach, and the authorities of Dade County. Other information was obtained from the concerns offering service to the charter boat fleet as well as by personal count and recheck wherever possible. Cross-checks were made wherever the nature of the information made them possible. The Miami Area was defined as that area as far north as, and including, the Dade County Docks at Baker's Haulover; southward along the ocean and bay front to the area known as South Bay, which fronts on the municipality of Coconut Grove.

*Contribution No. 56 from Marine Laboratory and School of Business Administration University of Miami.

In assigning the dollar value to the trade it was not intended that the totals iven would represent a total economic value, in the gross sense, of charter oating to the Miami area. More specifically, the totals given represent the urrent market values of investments in the business itself, and do not represent ıvestments in service activity or in the secondary trades, such as the dockage acilities themselves, which may or may not be dependant on the activity of he charter boat fleet. Any dollar value assigned here is subject to the same ariables that govern the total economy of the country. As Dr. Richard A. Kahn has pointed out in his paper entitled *Principles of Evaluation of Fisheries*[1] he value which is assigned at present may not be relatively the same as that alue which the industry may grow or decline into nor the same as the historic alue. Dr. Kahn says further, "Since prices [refering to the evaluation of isheries] are values expressed in money and currency, it is impossible as a asis of evaluation, to find prices which would be appropriate and correct nder all conditions."[2] With this in mind, the values assigned here are based n the market values of 1950 and none is less current unless so stated.

Within the Miami Area there are three dockage facilities that can be considered of major importance by virtue of the number of charter boats located here. Haulover Docks, located on Highway A-1-A north of Miami Beach, and under the supervision of the Dade County Park Association, has thirteen charter boats, which range from 36 to 40 feet in length. Some of these are as much as twenty years of age, and all charge $60 per day as the charter price. Within the City of Miami Beach, and under the jurisdiction of that municipality, are the Chamber of Commerce Docks. This berth has facilities to handle seventeen charter boats and at the time of this study the craft there ranged from 36 to 40 feet in length. All of these charge $65 per day as the charter price. By measure of size and fame, the largest of the three major facilities is located in the City of Miami Yacht Basin and is known as Pier 5. Under the control of the City of Miami, Pier 5 has facilities for a large number of varied craft and at the time of this study there were thirty-five charter boats located there. It is well to remember that the number of craft engaged in the charter boat trade varies from year to year and from season to season. At the time of this study there were 94 craft counted in the Miami Area, including the three major facilities as well as a number of minor ones. New fleets of charter boats have been known to spring up over night and old ones have broken up just as rapidly. Because the figure of 94 craft represents an observed total at a given time it has been used in determining the values assigned to the fleet.

The initial investment of the charter boat operator is linked to the income that he might expect from his equipment. Newness and appearance of his craft as well as the general appearance of his auxiliary equipment do much to induce prospective charterers to choose his boat over others that are currently for hire. Most prospects survey the craft at the docks the night before, and it is this appearance of the craft coupled with the personality of the owner, an economic intangible, that will direct the choice of the prospect. Some operators are well known and have a good reputation throughout the fishing circles that charter these craft.

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1. Richard A. Kahn, *Principles of Evaluation of Fisheries*, U.S. Department of the Interior Commercial Fisheries Report, ECML-2, Washington, D. C., April, 1947.
2. Ibid.

This study found that the majority of the craft used in the charter boat business were not originally designed for such operations and have been subsequently adapted after they were purchased second-hand. The rate of depreciation on such craft is high, representing primarily the decline in market value of the craft. Examination of brokerage scales, covering the market value depreciation, showed that, as an example, a craft of the 26 to 40 foot class which was built prior to 1930 will have depreciated in current market value from 60 to 75 per cent below the original cost. Craft of this class purchased in 1950 are faced with an immediate depreciation of 20 to 25 per cent in market value. This depreciation is in effect a statement of the condition of the market for pleasure craft in Florida waters. Specifically it applies to the Miami area and is current for January 1, 1950.

The purchase of a new craft with the required equipment and the miscellaneous paraphernalia, on the current Miami market, would represent a minimum investment of $23,000 for a craft of the 40 foot class, while one 32 feet in length, purchased new and fitted for charter boat operations, would represent a minimum investment of $16,000 under the current conditions. If operations off Bimini are to be undertaken by the operator, investment figures for each class of craft cited would be increased by at least $1,000. Because of the personal nature of charter boat fishing, the men in the trade are reluctant to divulge information concerning their business. It has been nearly impossible to gain complete information on the extent of investments. As a result, it has been necessary to assign a reasonable average value to the craft for the purpose of evaluation of the entire fleet. This has been done through consideration of age, length and initial investments, based on current values.

The maintenance and operating costs of the charter boat owner depend on a number of variables. Location at Pier 5, for instance, will require payment of a yearly dockage fee of $200, while location at the Chamber of Commerce Docks will represent a fixed charge of $240. The monthly dockage fee varies with the season of the year, being the greatest when the most tourists are in the area. Other fixed charges against income are represented in the necessity for hauling the craft and painting it periodically. Other charges are for engine maintenance, depreciation, license fees and taxes. These represent an average fixed charge of $1,500 per year for a craft whose initial value was $19,000 and which is being depreciated over thirty years (an unusually long period) to a scrap value of $700. In addition to the long period for depreciation, other fixed charges were considered as minimal, so that the result would show as small a fixed charge a year as possible.

Variable costs in the operation of a charter boat are easier to determine. Survey showed that fuel for one trip ran an average of $10 and the salary for the mate the same, the mate not being paid on non-chartered days. To this $20 can be added the cost of oil, ice, and bait which would bring the variable cost for a day on which the boat is chartered to $25.60. Since the average price charged throughout the fleet for one charter day is $60, this variable represents a constant of 42 per cent of gross income. These figures are used in the preparation of a break-even chart for varying numbers of days of operations (Fig. 1).

Weather considerations for charter boat fishing activity in the Miami area were surveyed and it was found that during the eight months from September through April there has been for the last four years, an average of 3

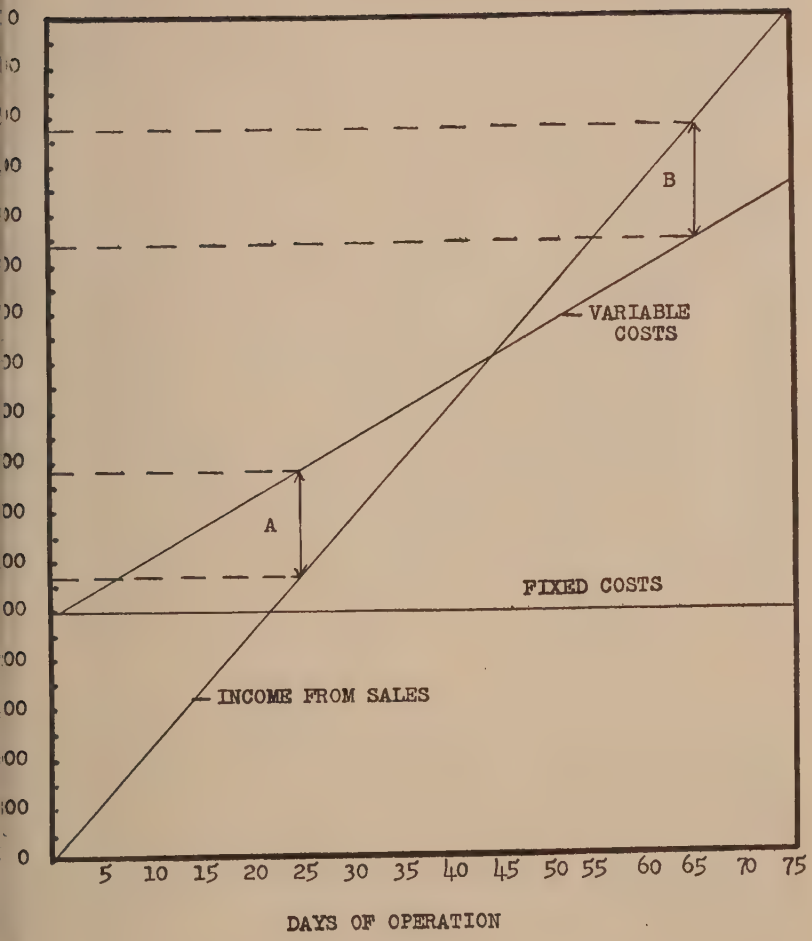

FIGURE 1

BREAK-EVEN CHART

THE VARIABLE COST LINE, also representing total costs, crosses the income from sales (charter trips) line during the 44th day of operations. "A" is the loss potential for only 25 days operation while "B" shows the profit potential for 65 days operations.

days a year during which the weather prevented fishing. This is the result of small craft and hurricane warnings alone. Rain was not given consideration because of the nature of the weather in the Miami area. For the eight months of greatest charter boat activity, and with an average of $60 per charter trip, this represents a loss potential of roughly $1,900 in gross income per operator per year. The expenses incurred by charter boat operators in seeking haven during hurricanes and for the repair sometimes necessary as a result of hurricanes can not be charged at a fixed rate against income since it will vary so widely between the individual owners.

In attempting to determine the break-even point in operating a charter boat, it was necessary to assign an average length and value to one craft of a hypothetical nature. It is felt that the figures are representative. Assuming the fixed costs to be $1,500 per year for the average length and age craft, with the representative variable costs being 42 per cent of gross income, it can be seen from plotting this on a break-even chart (sometimes called a graphic profit and loss statement) that the point at which total income equals total expenses comes during the 44th day of operations at the end of which the operator will realize a dollar net income of $31.20. At the end of the 45th day of operations, the charter day following the one in which expenses equaled income for the year, it can be seen that the operator will realize a net total dollar income for the 45 days of $66. Some operators will realize a larger net income than others since their equipment does not represent a fixed charge as high as the 25 days operations necessary to break even that has been assigned to the average craft. The break-even point of others will move much further to the right since theirs is much newer and more expensive equipment. For the hypothetical average craft presented, the accumulation of days of operation would represent income figures about as follows:

50 days operation	4 days net income or $ 240
75 days operation	19 days net income or $1,140
100 days operation	33 days net income or $1,980
150 days operation	62 days net income or $3,720

These figures can be broken down into monthly incomes to show that for 150 days operation the operator would receive an average monthly income of $310, while for 100 days the income would be reduced to $165 per month. It can be seen from this that for charter boats to be profitable it is necessary for the owner to operate well over 100 days during the year. In this connection it should be remembered that no fixed charge has been applied to cover any withdrawals from the income to meet the needs of subsistance. The study showed that a few operators make a good income from the charter boat business, but that by and large the average operator is merely keeping his boat from year to year. Many operators are eating their depreciation each year represented by the withdrawals for subsistance.

In assigning a dollar value to the primary investment in the whole of charter boat fishing in the Miami area, several of the things already mentioned must be taken into consideration. The fact that the numbers engaged in the business are constantly fluctuating can change the total investment figure by as much as 3 per cent with the probable figure being plus or minus 1½ per cent at any given time. In order to estimate the total value of the primary investment in terms of current market value it was necessary to determine the average age for the craft in the area. The study showed an average age of 10.4

ears. Along with age it was necessary to determine an average length for the raft in the trade. It was found that the boats averaged 38 feet in length. Using ıe price of a new 38 foot craft on the Miami market, $17,000, multiplied by he 94 observed craft, would give an investment figure of a rounded $1,410,000. 'his figure, depreciated by the average age of the craft, would represent a eduction of $510,000 and would set the current market value of the Miami harter boat fleet at $902,000 plus $188,000 for non-depreciable equipment, or a total investment on the current market of a rounded $1,110,000. This would place an average of $11,700 for each of the 94 craft surveyed. Comparison of these figures with studies made of the Middle Atlantic Bight in 948 shows only slight variations in values assigned.[3]

To determine the total income figure for the entire charter boat fleet in the Miami area was impossible as a factual survey. Well substantiated opinions 'rom dockmasters and individuals in the trade, as well as those associated with t, showed that the greatest number of operators are just breaking even each year. If this is the case and a subsistance wage of $150 per month is assigned as a fixed charge against operations, it can be seen that to break even under these conditions, the operator must be chartered at least 95 days.

By considering this fixed subsistance charge in the light of the income fate of the trade, it can be assumed that an average of slightly less than 100 days per year is applicable to each craft. This being the case, the gross income for the trade would be a rounded $560,000 per year. The frequently asserted statement that charter boating is not generally profitable would appear to be true. The only consideration that can not be evaluated is the type of life that the trade affords. There is strong evidence that this non-monetary income derived from the pleasures associated with the work is a large consideration upon entering the trade. Some operators say that charter-boating is an avocation rather than a vocation with them.

Based on the previous premises, approximately $177,000 will be spent each each year from the primary trade for their subsistance needs. Another $94,000 will be channeled to the Miami merchants through the $10 paid to the mates for each trip. For gas, oil, bait, and ice another $140,000 will be spent annually, while $22,000 will be spent by the operators for the services they need for maintenance and repair. At least 36,000 people are carried yearly on the charter trips. It would be impossible without a very complete survey to determine how many of the 36,000 came to Miami for charter fishing alone. It will be remembered that these figures are presented for consideration only within the limits that have been placed on them. The validity of the figures concerning incomes to the Miami merchants rests entirely upon the accuracy of the estimated average number of trips per craft per year.

Charter boat fishing in the Miami area is typical of this type of operation as it appears in other areas of the country. It is almost entirely dependent in the Miami area on the tourist trade. Indications point to an expansion in the numbers of tourists who may come into the Miami area as more and more efforts are made to bring the tourist into Florida for summer as well as winter seasons. This expansion may or may not help the lot of the individual operator.

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3. See: Raymond J. Butler and Harlan S. Spear, *A Survey of the Sports Fishery of the Middle Atlantic Bight in 1948*, United States Department of the Interior, Fish and Wildlife Service, Special Scientific Report—Fisheries No. 7, p. 2.

Whatever the position of the trade may be in the future is dependent upon one group of people—the tourist who comes to the Miami area whether expressly to go deep-sea fishing or not.

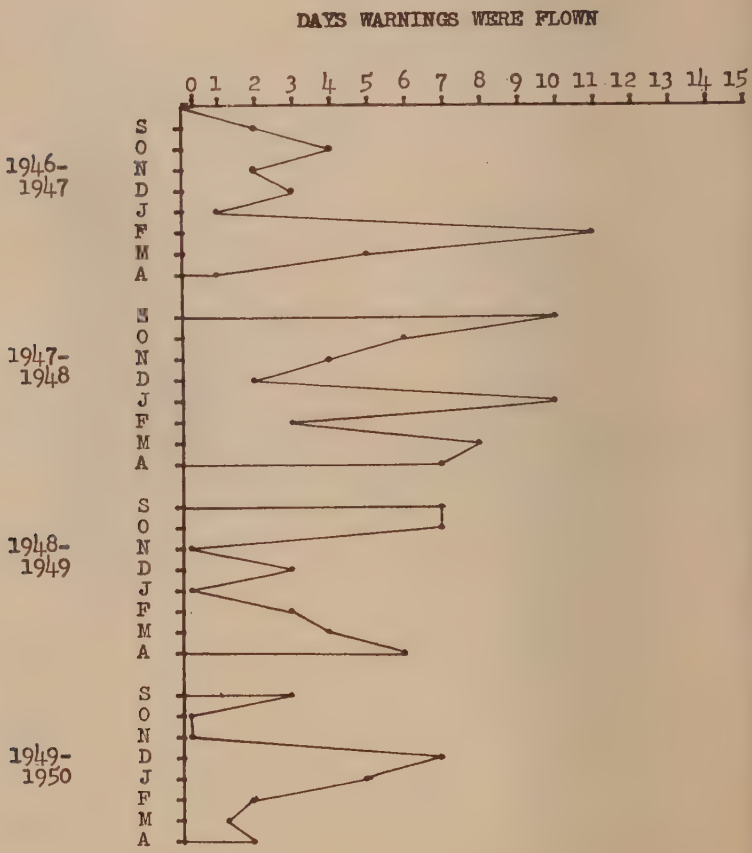

FIGURE 2

FREQUENCY OF SMALL CRAFT WARNINGS

SMALL CRAFT WARNINGS from September through April for 1946 to 1950. Hurricane warnings are included. Small craft warnings are hoisted by advisory from the U. S. Weather Bureau when the winds are expected to exceed 25 miles per hour.

FISHERY ADMINISTRATORS SESSION

'hairman—F. G. Walton Smith, Director, Marine Laboratory, University of Miami, Coral Gables, Florida.

Fishery Administrators' Problems

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There has never been, to the writer's knowledge, a definition of exactly what fishery administrator is. True, fishery administrators are frequently described, ut generally by some snappy adjectives which go far back into their ancestry. A description lacks the value of a more precise definition, however, and in the bsence of an authoritative definition of the species, an attempt will be nade to provide one: A fishery administrator is a citizen who is expected o start with an indefinite, indeterminate number of unknown variable atural factors, including the factors of human nature, and without the benefit f any recognizable formula or recipe, add these elements together to produce constant, stable, unfailing, maximum supply of catchable, marketable, or rofitable fish or shellfish. If it is thought that this definition involves some xaggeration, let us analyze the situation.

We will start with the ingredients that the administrator has to work with in rying to get results. His raw material is the existing seed stock comprising the resent fish and shellfish populations in natural waters. He does not know vhat these are, where they are located, or how many of them there are. Of ourse, he has hints and clues to these factors, but these hints and clues are ubject to year-to-year, month-to-month, and even week-to-week changes rought about by the whims of Nature, the intensity of fishing, etc. For xample;

What is the distribution by species, quantitatively, seasonally, by size, and eographically, of shrimp in the Gulf of Mexico or South Atlantic waters? 'his ought to be easy since shrimp have been a No. 1 crop in these areas for long time, and sound administration of the shrimp resource should certainly e based upon a precise knowledge of these factors. Who can, or will, supply ne details just mentioned? Or, again, how many shad should be allowed to pawn in any given river in comparison with the number netted and shipped o market? Does the catching of undersized fish—trash fish, if you will—ctually deplete stocks or does it simply weed out a natural excess or surplus hich would never grow to maturity anyway? What makes the spawning of ullet so much more successful in certain years than in others, or, to put it ifferently, why do recurrent variations in the size of year classes of almost very species of fish exist? In brief, how are things in the Gulf stream and very other square mile of water on our coast?

The questions are not theoretical or academic. They are matters which every shery administrator is called upon to consider. To repeat: the fishery admin-

istrator starts his functioning with a background of a vast, unorganized ignorance, illuminated by occasional flashes of traditional legend, hearsay, inference, assumption, guesswork, and, praise be, an increasing backlog of scientific theory and fact coupled with the experience gained from trial and error. The administrator, having no firmly fixed starting point of fact, must then chart some sort of a course in the hope of arriving at the only definite landmark in his harassed existence—that represented by a stable, sound, productive fishery. This part of the job, nevertheless, might be considered relatively simple, calling for nothing more than a system of Spartan, conservative restraint and restriction upon the taking of fish. By always leaning over backward in regulating, giving the resource the benefit of the doubt, it might be possible to come up with reasonable assurance of protecting the resource, except that the economic survival of thousands of individuals, hundreds of communities, and dozens of counties, may be affected by the administrative action taken.

Thus, the problem immediately becomes one of balancing the inherent—and unknown—productive capacity of the fishery against the economic needs of the fishermen and related enterprises, and against the political demands which arise out of these needs. This human factor is probably the trickiest element in the whole baffling, complex cross-fire which characterizes our present efforts at fisheries administration and management. In fact, this brief highlighting of the problems which face the administrator has already made the writer so sorry for the poor wretch that is is hard to go on, but we certainly owe it to him to straighten out his troubles if we can.

The whole situation is too complicated for us to try to take time to work out all of the ramifications. However, because of the nature and character of this conference here at Miami, we can profitably cast a glance at one aspect of the problem—that of fact-finding or research. Many here may be ready to deny indignantly that there is any such shortage of basic information as has been indicated above. Actually, there is a lot of piecemeal, fragmentary information which has been laid before the administrator, like a half or a quarter of the total number of pieces in a jig-saw puzzle. He can put these together, filling in the missing pieces as best he can, and trust that the picture revealed is something approximating Nature's own design.

He *can* do this; sometimes he doesn't even try because he, or those he serves, may be inherently distrustful of scientific data as contrasted to so-called practical knowledge and experience. Maybe he doesn't try because the information divulged by the researchers is presented in an unintelligible, undigested unusable form, or sometimes because the data are inconclusive or conflicting in substance. The administrator in turn may expect altogether too much of science failing to recognize that the biological sciences lack that clean-cut, sharp precision that marks the mathematical or physical sciences. In biology, Nature never does anything on an absolute 100 per cent basis. She always gives herself so many exceptions, variations, and abberations that almost every biological conclusion has to be qualified to some degree. Nevertheless, if the type of fishery research which is now being organized had been prosecuted as vigorously for the last 50 years, the administrator would be stripped of his principal alibi for failure and his problems would be cut down to size.

After all, knowledge can be stockpiled and drawn upon any time for almost any conceivable purpose. The chief current headache of the fishery administrator, perhaps, is the fact that the knowledge stockpile has barely been started

and is presently little more than a lump rather than a pile. In justice to the research people, we administrators should frankly, and maybe shamefacedly, admit that we actually haven't adopted and applied much of the information that is already available to us. The reasons for this are numerous and seemingly compelling, and some of them can perhaps be brought out in the discussions on this program later this afternoon. It is probably true that the fishery administrator is suffering right now from a slight case of factual indigestion, or shall we say, constipation. Anyway, we haven't assimilated all of the scientific nutriment that is ours for the taking. Let us leave this point with a statement of a paradox. There is now a serious shortage of basic scientific data and at the same time an insufficient recognition and use of the data that we do have. The way out of this dilemma seems easy, at least to prescribe—both get and use more facts. When it comes to using facts, the administrator gets involved in another paradox. He should assiduously employ horse sense in settling fish problems. What he does must be weighed and measured against practicalities which the fact-finding research man can and maybe should ignore—up to a certain point. If the researcher goes beyond that point into theoretical realms, he may achieve a measure of self-satisfaction in serving eternal truth, but he is of no more service to the administrator than a hole in the head. So, if the researcher is sometimes impatient or hurt because his findings are summarily ignored by the executive or administrator, let the fact-finder ask himself: Is my product usable? Does it make sense in a practical, workaday, imperfectly human world?

Speaking of utility and action, the administrator is expected by the public, by his technical and scientific colleagues, and generally by his own conscience, to *Do Something*. He is expected to *Get Action,* for the purpose of maintaining, restoring, or actually creating prosperous fisheries. Here let us insert a loaded question: "Aren't there a good many instances where a fishery administrator can do his job better by doing nothing?" Does it always follow that man's juggling of marine resources through regulation or by any other artificial means will automatically preserve the resource any better than Nature's own vast protective and restorative powers or bring about better human utilization of that resource? Some of you here will recall a situation which occurred when one investigator, after studying the Chesapeake Bay crab for several years, handed in conclusions which inferred quite clearly and plainly that protective regulations would be largely a meaningless gesture as far as having any direct effect on crab stocks was concerned. Administrators were ready and anxious to do something in this particular situation and were thrown for a loss when confronted with such a negative attitude. Aren't there situations in other fisheries where official inaction may be as beneficial and have as much merit as official action? Please don't misinterpret this. This is not an advocation of "Let well enough alone" as a general policy for fishery administrators. It is simply an advocation of a certain amount of vertebral rigidity—this is a more refined way of saying intestinal fortitude—in resisting pressure toward stampeding into unnecessary or ill-conceived measures alleged to be imperative in the interest of better management of a fishery resource. Is there or is there not any validity to an assertion occasionally made by a certain individual—namely, myself—that economics may, under certain conditions, be the most effective conservation measure that man has ever devised? To elaborate—when it is no longer profitable to fish, fishing stops, and there is always enough seed stock left to bring back the

resource. This is probably applying conservation and management the hard way, but it does work.

What has been said here about the problems of fishery administrators can be illustrated by a case history which has occurred within the last two months. This is mentioned without the slightest intent of implying any criticism against the people involved, and in fact, the writer has the strongest respect for them. Out in the Pacific Northwest, there is an organization known as the International Pacific Salmon Fisheries Commission which has the responsibility of conserving, managing, and administering the Fraser River salmon fishery. This organization is well financed, admirably staffed with the highest calibre of scientific and technical personnel, and in general has been continuously held up as a classic and an ideal example in the field of fishery research and regulation. Furthermore, it is dealing with an anadromous species—salmon—which conveniently and cooperatively resort to man's own backyards for reproduction which permits a degree of observation, analysis, and study which is probably not duplicated with any other species of fish. The Salmon Commission, on the basis of its years of study, had determined that the 1946 spawning seed stock in the Adams River area, a tributary of the Fraser, was capable of producing an abundant return during its cycle year of 1950. Preparations were made for an intensive commercial fishery based upon the fact that all of the known data amply supported a forecast for a good salmon run. It has been said that some five million dollars was the expected revenue from this run. Regulations were carefully prepared to take advantage of this jackpot. But something slipped. Only a pitifully small fraction of this anticipated silver horde showed up. Economic distress is already indicated. The Salmon Commission had hastily to correct its regulations in order to conform to this new set of circumstances. Here was an organization which was as well qualified as any in existence to call the shots and to act sanely and soundly in the management of this fishery. Yet the painful fact is that the organization was double-crossed by Nature somewhere along the line. The scientists and administrators making up this group may be criticized, but such criticism is unwarranted and unjust. They simply ran into one of those inexplicable phenomena which can upset the soundest planning and administration. The same thing can and will happen in other fisheries. The only insurance policy that can be written against it is to build up our reserve of knowledge regarding all phases of all of our fishery resources.

In conclusion, all the foregoing has attempted to make two bascically simple points. They are: (1) admiinstrators can do their job efficiently in direct proportion to the volume of reliable information available to them, and (2) the principle of doing first things first dictates that the research should be slanted directly toward answering present and pressing, urgent, practical questions. It should, by all means, be accompanied by concurrent research into more abstract fields of fishery biology, oceanography, and related sciences, since these latter studies are the ones—and the only ones—which will give that final and conclusive last word. It is hoped that the ensuing discussions will provide an opportunity to clarify some of the points, issues, and policies which concern all of us who have to translate ideas into action.

Problems Of Fisheries Administrators In The Atlantic States

David H. Wallace, *Chairman*
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Fisheries administrators along the Atlantic Coast have at least one thing in common. They are almost continually being placed on the defensive by commercial fishermen, sportsmen, conservation clubs, or affiliated interests which are dissatisfied with fisheries conditions, and believe the administrator is solely responsible for the unsatisfactory situation. What is there about the industry to generate such heated emotion and controversy for so many years?

The answer is complicated. By attempting to analyze some of them it is hoped to portray a few administrative problems that currently exist along the Atlantic Coast. Illustrative examples which have been documented in Annual Reports of the Atlantic States Marine Fisheries Commission will be presented. Interstate matters also seem to fit into the pattern, but few involve all the factors included in the discussion.

Fishery administrative problems are generally a complex of biological, economic, sociological, judicial and political pressures so interlaced it is difficult, and sometimes impossible, to separate and analyze them. Few administrators have been fortunate enough to be faced with a fisheries problem that is strictly biological. Unfortunately, when that happens, the administrator usually finds there has been little or no research on the particular problem involved. Some officials then decide they must wait from five to twenty years for the research to be accomplished, (assuming funds for research are available immediately) and in the interim, nothing is done because of inadequate information. This situation has arisen in a number of Atlantic states and may be compared to an illness the physician is unable to diagnose. Instead of attempting a remedy on a trial and error basis, the doctor says, "We do not know the answer, so we will do nothing. It is too bad if the patient dies but it cannot be helped. Treatment will have to wait until the exact cause has been determined and specific drugs perfected to effect a cure."

Few people today would be satisfied if the medical profession assumed that attitude. Nor should our fishery administrators be complacent enough to take such a position when faced with a comparable problem. Fortunately, most of our administrators do not reason along these lines. It is obvious that in our life time we will not know the biological answers to all of our fishery problems. But in the absence of such complete knowledge it is essential to utilize the facts at hand, on an experimental basis, in the hope that the right management formula can be deduced and applied. This procedure offers the opportunity for much quicker solutions to some of our biological problems. Maryland is now embarked upon such a program. There biologists are attempting to evaluate results, so that the management equation can be changed, if it does not solve the problem. This method of approach to fisheries problems might be termed "experimental management."

The greatest advantage of this approach from a research standpoint is that it enables the scientist to inject a single variable into a problem in a controlled manner. The administrator, on the other hand, is always subject to intensive pressure to relax existing regulations before sufficient time has elapsed to evalu-

ate the experiment. Every state administration along the Atlantic Coast is recognizing the need for additional biological information. Ever increasing requests for expanded research are being relayed to the proper authorities by the Atlantic States Marine Fisheries Commission.

Within the past five years fisheries research groups have been established to some degree in almost every state along the coast. At the same time, additional encouragement has been given the federal government in expanding its research program. Errors of judgment have been made, it is true, in deciding whether a specific problem should be attacked by the Federal government or by the states involved. However, considerable progress has been made toward expanded research, and the Atlantic Coast administrator can look forward to getting more facts, that will help solve some of the many pressing fishery problems confronting him.

Local species of fish which do not migrate widely are usually classified among the easiest to manage. In such cases the administrator can act with a minimum of delay. This is not true of migratory species, which move from the territorial waters of one state into another. An excellent example is the shrimp, which is abundant from South Carolina to the central portion of Florida's east coast. Here the administrator has been supplied with many biological facts and recommendations but they are not applicable because of sociological, economic and political factors.

Individual shrimpers are reluctant to have restraints placed upon their operations since these may result in increased catches elsewhere. The small dragger is at odds with the large dragger and sportsmen in turn are at loggerheads with the commercial operators. The administrator is then faced with a course of action which will attain the desired results and at the same time placate the determined demands of the special interests. Administrators in the South Atlantic States are meeting this challenge by a united front based on facts. Their programs will be accomplished only after all groups concerned are properly educated to the facts.

The problem of fishery controls in Delaware Bay, however, are not nearly so simple. Here Delaware and New Jersey have a joint fishery, but act under independent laws which do not necessarily bear any relationship to each other. Biological facts, sufficient for management, are not available for most species with the result that it is difficult to bring order out of the confusion. Again economic and political factors exert an important bearing on the problem. Because neither state has lived up to a solemn compact made many years previously, there is mistrust on the part of political and industrial leaders of any action taken by the other state. The administrators must in this case assure the leadership in order to dispel this mistrust and to guide the two states to some mutual understanding.

The Maryland-Virginia relationship is somewhat the same, although these states do have the benefit of many years experience in attempting to solve common problems. As is so often the case, however, even if agreement is attained the home fishermen and political leaders are not necessarily convinced of the soundness of the program, and may refuse to cooperate in its fulfillment.

Traditionally each state has assumed the responsibility for managing its own fisheries affairs. This has resulted in a hodge podge of laws and regulations which all too frequently have no real basis except possibly to please one o

more special interest groups. The fishery administrators, at the earliest possible time, must dispense with this limited sectionalism in so far as migratory marine species are concerned and begin to consider the overall needs in a given fishery. The migratory striped bass is an example. This fish migrates from Chesapeake Bay to Maine and back again. Each state has an interest, either from a commercial or sports-fishing standpoint. The administrator must be informed of the biology of this species before taking a position on its management in any given locality. It is probable that the Atlantic States have done a poorer job of managing the striped bass than almost any other species. In spite of extensive research, legislation has been enacted in some states which is entirely illogical. The state of New Jersey, for example, prohibits the commercial capture of striped bass in her waters. And yet, all the bass found in New Jersey are migrants moving either north or south along the coast. Since bass do not spawn in New Jersey waters, this prohibition has little or no bearing on the total population. The administrator in such a case must lead the way by pointing out the inadequacies of the law. This must be followed by suggestions for amending the outmoded statute.

These cases have been given to demonstrate the difficut and diverse problems facing the fishery administrator today. Most administrators are faced with problems of management on non-migratory species which are just as difficult as those described above. He must fight a deeply engrained tendency on the part of watermen to resist the adoption of new methods and the application of new techniques. He must evaluate and handle pressures originating from both the commercial fishermen and the sportsmen. He must referee disputes between various segments of the commercial fisheries, who are competing with each other for a share of the same fish population. And finally, he must resist the efforts of pressure groups to influence his decisions because of political expediencies of the moment.

In closing let us consider personally the typical fisheries administrators of the Atlantic Coast. Before assuming their present capacities they were either real estate salesmen, lawyers, politicians, biologists or fishermen. None is fully equipped by training or experience to meet the diverse problems confronting him. Yet all are striving sincerely, usually against almost insurmountable odds, to improve the fisheries, and thereby raise the economic and social level of the people of their states. The Atlantic States Marine Fisheries Commission has done a great deal to inform and help the administrators, and to equip them better for their jobs. Even at best, however, the job is not easy. Pity the poor fisheries administrators! In addition to the burden imposed by his fishery problems in most cases he carries the weight of the electorate on his shoulders.

Problems Of Fishery Administration In Florida

GEORGE A. VATHIS, *Supervisor, Florida State Board of Conservation, Tallahassee, Florida*

ACCORDING TO THE LAST FEDERAL CENSUS Florida is the third fastest growing state in the union. Its population has increased 46 per cent in the past ten years, and people still are moving in at the rate of 1,000 a day. Communities are growing into towns and towns are growing into cities. Industries are mush-

rooming, businesses are expanding and resources are being explored and utilized at an unprecedented rate. Such phenomenal growth must inevitably be accompanied by a few growing pains. Pangs already are being felt in the form of overcrowded schools, bulging thoroughfares, social service problems, mounting cost of state and local government and increased pressure on natural resources. All of this, naturally, has had its effect on the administration of Florida's salt water fisheries. Today a record 9,000 commercial fishing boats are plying our coastal waters; retail seafood establishments are multiplying at the rate of 200 a year; this winter well over a million sports fishermen will line our beaches and bridges and troop aboard our charter boats to sample Florida's fabled salt water fishing, and scores of new resorts and businesses will spring up to take care of them.

The whole thing constitutes a tremendous business—a business dependent entirely upon a productive salt water fishery, which in turn is dependent upon us, the conservation administrators. It is a tremendous responsibilty and a responsibility knotted with problems. The swift growth of the state has not actually *created* the problems, however; it has simply brought out in glaring relief the same difficulties which have been in existence for years. Any state with Florida's geographical design is bound to present a tidy bundle of conservation headaches. First it has 5,000 miles of coastline, gashed by more than 70 tidal streams and fringed with innumerable islands and capes. That creates a major enforcement hurdle. Second, it is a long state, extending roughly 900 miles from Key West to Pensacola and exhibiting all the varied climatic conditions to be expected over a 900 mile distance. It is not unusual to find a winter temperature variance of 40 degrees between northern and southern extremities. Naturally this tends to complicate any sort of uniform management program. On top of this, Florida's population, economic and social outlook vary as sharply as its geography and climate. Generally speaking the lower peninsula and much of the whole east coast is populated by former Northern residents, who came to the Sunshine State in comparatively recent years. The emphasis there is on tourists and tourist attractions. On the other hand most of the upper West and North Gulf Coast counties are made up of long-time residents who tend to stick to their farming, fishing or their turpentining, and often display a thinly veiled antagonism to any attempt to infringe upon their individuality. Though the differences are not as marked as they once were, the aims and philosophies of the two sections are still far from parallel. This makes any attempt at uniform regulations a particular knotty undertaking. A bitter conflict between sports and commercial fishermen has created similar problems in many sections.

These are nonetheless details rather than problems in themselves. The real problems confronting salt water conservation in Florida can be divided into three parts: (a) a shortage of funds; (b) a shortage of knowledge; and (c) a *surplus* of laws! These are three problems that must be solved before Florida can get on the path toward an earnest and effective salt water conservation program. However, they cannot be solved one at a time with any degree of success; there must be a three-front effort, with a gain here and a gain there until we are safely past all three.

Speaking from an administrative standpoint our present statutory tangle is particularly hard to unwind. At the present time Florida has a total of 41 laws affecting salt water conservation. Of these 170 are general statutes or rul

of the Board. The remainder—a staggering 250—are either local laws or general laws of local application. When we consider that less than 20 species of marine life are specifically regulated by law and that a maximum of 39 counties are involved, it is easy to see the problems we face in interpretation and enforcement. When the writer took over the supervisor's post there was not even an existing compilation of salt water laws. They were scattered at random through countless volumes of Florida law, some dating back 40 years or more. It was impossible for anything less than a trained legal mind to ferret them out. The Attorney General's office was asked to bring some sort of order out of the existing chaos. Significantly it took the Statutory Revision Department nearly a year to find and compile the mountain of legislation.

The result at least showed us where we stood, but, if anything, it further complicated enforcement procedure. As the Attorney General's office so aptly put it, "The laws of Florida relating to salt water fish and shellfish have accumulated through the years into a patchwork that defies the layman to discover just which laws now apply in many counties"

So many local and general laws have been passed down through the years that the result has been duplication, contradiction and sometimes a bewildering mixture of both. It was apparent that many laws were passed without knowledge of existing legislation; some, by implication, repealed *portions* of old laws but left confusing fragments of their predecessors in full force and effect. The result is that in some counties it is next to impossible to determine where one law leaves off and the other begins.

Many of these acts were general laws of local application adopted via the so-called "population" system. Under this system the act is written into the book as a general law but is made to apply only to the county or counties within a given population bracket. The net effect is a "local law." However, in many cases, counties for which the regulation was originally designed have grown out of the specified population bracket and other counties have innocently grown into it. For example, we are currently in the unique position of having a solemn and fully valid closed season on mullet roe in Gadsden County by virtue of such a law. Gadsden county is a renowned tobacco and peanut producing area lying a full 60 miles from the Gulf of Mexico! This particular law is an old one and it is not known which county it was originally intended for, but certainly it wasn't Gadsden. Another inland county recently woke up to the fact that it had a full-fledged shrimp netting law, while its coastal neighbor, for which the law was intended, had none.

Some local laws of particularly ancient vintage apply to specifically named counties which have since been carved up into two or more counties, thus raising a ticklish jurisdictional problem. Other local laws are diametrically opposed to the provisions of certain general laws. For instance, a minimum mesh size may be set out on a statewide basis in a general act; then along comes a local law providing that fisherman in Whositz County may employ mesh a half-inch smaller. Other counties follow in its footsteps and soon what, on the books, is a statewide regulation becomes almost totally nullified by a rash of local legislation.

Many other well-intended and potentially beneficial laws have lost their effectiveness through loose construction or failure to cover enough ground. Although it may be hard to conceive, there are prohibitionary statutes that

are so limited that they fail even to provide for the seizure of evidence! In one county it is illegal to set crawfish traps, but there is absolutely no provision for the seizure, confiscation or disposition of the traps. Thus we are faced with the problem of catching the trapper red-handed, then leaving his traps intact to go into court with a "my word against yours" case. In other laws there is authorization to seize illegal gear as evidence, but it may be confiscated only upon conviction. In cases of "runaways" or a bond estreature (which in Florida does not necessarily constitute a conviction) where no conviction goes on the record, we are nearly always left in a legal muddle.

This assortment of contradictory, outdated and overlapping statutes leaves fishermen, conservation agents and even judges in a perpetual state of confusion and makes effective enforcement a virtual impossibility. Until the existing laws are weeded out, simplified and strengthened, the Conservation Department faces a well nigh insurmountable administrative problem.

In the process of threshing out problem c — shortage of funds — we are bound to land in the middle of problem b—shortage of knowledge. This problem is more than anything else responsible for the bewildering surplus of laws. The obvious tendency is to put the blame on the legislature and let it go at that, but that is neither fair nor just. In most cases it was acting in what appeared to be the best interest of conservation. But its members lacked the same vital ingredient we are missing—reliable, concrete information on the needs for a productive fishery. Remember, they didn't even have a simple compilation of existing laws to guide them. Worse than that, they had absolutely no biological or technical data on which to base a decision. In the past two years the writer has discussed Florida salt water fisheries problems with dozens of lawmakers, and in every instance they are willing and anxious to enact good sound conservation laws. All they want are proven facts on which to base them.

These facts must be obtained in order to maintain a productive marine fishery. TIME magazine not long ago reported that one big industrial concern spends over a million dollars a year on scientific research, yet in all the years Florida has capitalized on its vast seafood and sports fishing industry, it has spent less than $100,000 on marine research! And until a very few years ago it had spent nothing! This sin of omission already has undoubtedly cost the state what was once a seven-figure sponge industry. Unless the seriousness of the situation is realized and action taken it will undoubtedly cost much more.

Currently we are spending less than $25,000 a year on biological research and only in the past few months have we been able to lay the ground work for a sound statistical program—certainly a basic essential in the administration of any fishery. The department has tried to keep production records, but the information on which they are based is so obviously distorted it is impossible to give them a great deal of credence. So, actually, we find ourselves in the dangerous position of not knowing where we are going. We think we know our fisheries production is dwindling, but we don't know how much or how fast. This information we *must* know, and along with it the scientific data necessary to doctor effectively whatever sicknesses may show up.

So far we have not even scratched the surface in our fight against this problem. We have done a little research on mullet, less on sailfish and enough on sponge to know we should have done it 10 years ago; a creditable oyster

habilitation program is under way. Of the numerous other food fish, game h and shellfish we know little or nothing. We frankly do not know whether ır closed seasons and length limits are wise or unwise. We have no scientific ıdings to back up our judgment, and until we do, Florida's salt water conrvation program cannot possibly be on sure footing.

Right now a controversy rages throughout the state on whether or not the ook should be placed on the game fish list. There may be a legitimate need r this action and there may not. We do not know the answer and only a ientific investigation of the snook can uncover it.

This is just one of the many perplexing problems the lack of scientific nowledge has produced. We are constantly confronted with questions from ɔmmercial fishermen, sports fishermen and conservation clubs that can not be ıswered because we have no findings to back up any answers.

The problem labeled a "shortage of knowledge" isn't necessarily confined to .e field of marine biology. The citizens themselves are woefully uneducated the problems of salt water conservation. A long-range comprehensive inɔrmation and education program has for years been an accepted essential in ost conservation programs. Here in Florida our fresh water colleagues have ıd such a program for nearly four years, but aside from a lecture here and ıere and a few elementary educational pamphlets we have done nothing. Why aven't we? That immediately brings us into problem a—shortage of funds. ıst as problem c, a surplus of laws, is a result of problem b, a shortage of nowledge, so is problem b the result of problem a, a shortage of funds. No ureau ever has quite enough money—in its own opinion—but if there was ver a legitimate case of budgetary anemia the Department of Conservation as it. Despite the fact that we are charged with conserving and protecting an ıdustry which brings in an estimated $500,000,000 annually, our total operatıg budget has never exceeded its present $214,000. Until 1949 the department as never spent more than $140,000 a year. This year our budget was raised ɔ $214,000, but subsequent economy cuts reduced the actual available funds ɔ $180,000. Out of this we were absolutely forced to make a fresh "capital ıvestment" of $25,000 in 11 new patrol boats. This cut our actual operating unds for the year to $155,000. As it stands now that is all the money available ɔ administer Florida's salt water fisheries program. On this amount we are ble to maintain a staff of 46 people, 41 of whom are conservation agents.

Though the bulk of the money goes for law enforcement, we are still voefully weak in that department. A total of 34 agents and 7 supervisors are harged with patrolling 5,000 miles of coastal and tidal waters. They do it vithout the aid of airplanes and without radios; in some cases they do it with ıothing more than a beat-up boat and kicker. By stretching a point we are .b'e to pay our agents an average of about $165 per month.

To do an adequate enforcement job, Florida should have 50 per cent more nen, well-trained, well-equipped, well-paid and secure in their jobs. But all ɔf that requires money, a commodity in short supply.

The same crimp in purse has held up our research program. This year we ıre spending only $22,778 on scientific investigation—roughly eight per cent ɔf the amount spent by our companion agency, the Game and Fresh Water Fish Commission. The facilities and trained scientists for this important work ıre available at the University of Miami Marine Laboratory, but the money so far has not been made available.

There are thus many knotty details, but the real basic problems in the administration of Florida's fisheries are interwoven in the three problems outlined. When those are remedied, our conservation program will be on its way to solution.

Problems Of Fishery Management In Maryland

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The objective of conservation administration appears to be that of promoting human welfare, whether the subject is soil, water, mineral, forest fish or otherwise. It seeks to do so by promoting effective practices and operations on increased quantities and volumes of fish—in the case here being considered. More specifically, conservation administration seeks to reach its objectives by stepping up the effectiveness of existing conservation agencies whether or not they are concerned with statutory regulations, education or the gathering of factual information. All of the maritime states have regulatory agencies, while certain others have one or both of the agencies concerned with fishery research and conservation education programs. Virginia and Maryland among others, have all three of these departmental activities, while most of the states are striving to that end.

The chief problem in fishery management generally seems to be that of relieving the administrative bodies from pressure groups as reflected in politics. There are a few states where this has been done to a marked degree, but in by far the greater number of instances there remains the element of fear and trembling as to where, when, and upon whom the politician in one size or another will descend, or when a management program will be curtailed or abolished because of the feelings and unthoughtfulness of little men. The writer speaks as a citizen from one of the states in the Union where marked progress has been made in the administration of natural resources, and where much of the political influence has been removed. It should be said, however, that the Maryland status is far from the millenium in this connection.

Natural resources belong to the people. Legislative action concerning them is an expression of the will of the people. The people, broadly speaking, want sound administration of the resources, including law enforcement. But the segment of the people directly dependent upon a resource, such as the fisheries typically, is greatly concerned that the *status quo* be maintained rather than desirous of trying new programs and improved administrative practices. Programs and their administration in the past have not been effective in all too many cases and areas. Thus the struggle goes on in which conservationists and administrators are striving to do a better job in maintaining and rehabilitating resources, and the operators, in this case the fishermen, are concerned lest some of the conditions surrounding them be changed, such as the size of fish, season of fishing, type of gear, or other restrictions. How, then, can the quality of administration be improved? The answer appears to be found in the educative process, a slow one to be sure, and in the acquisition of facts on which to build management programs.

Recently a governor of one of the East Coast states had a county leader go
) him with a delegation of watermen asking that the fishery laws of their area
ot be enforced. He and the watermen told the governor that enforcement
ould ruin his chances in the coming primary election. On the very next day
nother local leader, hailing from a contiguous county, led a delegation of
shermen to the same governor to advise that his defeat was certain if he did
ot enforce the identical laws. This situation is a characteristic one in the
dministration of fishery laws. There are many others less obvious, to be sure,
at of types that persistently gnaw at the very vitals of successful administration.

Such situations as these are inevitable when laws and more laws are put on
ie books, even by well-intentioned conservationists, without information upon
hich to base them. Actually, many of the fishery laws of today amount to
othing more than inefficiencies imposed upon watermen, a condition that
rovokes scorn on their part for those charged with the administration of the
sheries. What good, for instance, comes from a regulation that forces shorter
r smaller pound nets on an operator if he proceeds, in turn, to increase the
umber of nets he operates? A cure-all of the stove-league conservationists
, to require that "rest days" be instituted or that the season of operation be
ontracted in order to let the fish escape. Such restrictions not only do not
ncrease the runs, since added gears and efforts are applied to make up the
eficit in the individual's catch, but the additions cost money, take time and
equire more gear, thus, to increase the per pound cost of production and
njure both the consumer and the fisherman.

A new approach to the successful administration of the fin-fish resources
n Maryland to build them up, without at the same time materially disturbing
ne welfare of the watermen, was instituted in 1942. The essence of the new
rogram and the laws that implemented it rested upon the concept that the
shing effort should be controlled, especially in those fish, like the shad, that
espond to an increase in the brood reserve. At that time the supply of fish in
Maryland waters was at, or near, an all-time low. Many watermen had not
icensed at all, especially in view of higher pay from war industry, thus only
grass roots," or all-weather fishermen continued to operate. The new law
roze the catch effort, that is, limited the number of fishing license, at the low
evel of operators in the early forties. A comprehensive catch record system
vas set up. It was specified that additional units of gear could enter the fishery
nly when an increased supply of fish warranted same, and the criterion of
ufficiency was the escapement of brood stock.

This unique system has been in operation about eight years and there is
ndication that the supply of shad, for years badly depleted, has increased.
The escapement of brood fish has been built up in that time from 7 per cent
o 26 per cent of the shad run. There is indication that a 40 per cent escape-
nent is essential to the high yields expected from the shad fishery. Somewhat
ver one half of the desired run brood stock has been achieved.

Either by coincidence or by management, the striped bass, the basis of a
ishery that is important in the State, and one subject to frequent and marked
luctuations, leveled off in yields during the period in question, and now is
perating at a high level. The bass does not lend itself as readily to analysis
n this case as does the shad, thus the passage of considerable time will be
necessary to evaluate this situation in the administrative effort. It can be said,
however, that not only the striped bass but the other fish limited to the confines

of the State have shown less severe fluctuations in abundance in recent years than formerly, and there is indication, if not marked promise, that the administration of the Maryland Fishery Management Plan is working. Certainly the statistical program is demonstrating its value both economically and biologically, while the administrators have, in the overall, greater cooperation and a more marked interest on the part of the fishermen, who like the principle and practices employed in an effort to improve their lot through increasing the yields.

The Maryland Fishery Management Plan, and other administrative efforts to maintain and expand the fisheries, are working, as far as plans, laws, enforcement and the like are concerned, and regardless of the degree of success that can be established as resulting from them. We submit to you the type of organization employed in Maryland to indicate the progress that has been made in freeing fishery administration from political obstructions. That State no longer is involved in controversies as to what principles and practices should go into administrative work on fin-fish. Such problems as do exist are at the non-professional or appointive level and exert no influence of movement on the effectuation of the program outlined. We hope to learn from developments in the fin-fishery a way to reduce the administrative difficulties with oyster and crab resources where some improvement has been made, but much is yet desired.

FISHERY EXPLORATION AND TECHNOLOGY SESSION

hairman—Lawrence W. Strasburger, Vice-President, Envoldsen Shrimp, Inc., New Orleans, Louisiana.

Operation Of The Exploratory Fishing Vessel "Oregon"

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rom its inception it has been recognized that the overall program for heries research in the Gulf of Mexico has certain long range objectives that n be attained only by the integration of results from many kinds of research tivity. At the same time it appears reasonable to expect some immediately eful information from activities such as exploratory fishing. The *Oregon* s been operated with attention to both the long range and short range jectives.

The methods employed on the *Oregon* may be most easily illustrated by scribing recent fishing operations. Following a recommendation of the Gulf ates Marine Fisheries Commission, exploratory fishing for shrimp was begun July. This work was started with a survey of the area off the coasts of labama, Mississippi and Louisiana, near the mouth of the Mississippi. The ıter limit of the existing fishery for shrimp in this region is at about the 25 thom mark. Explorations of waters beyond this range were undertaken. In e late summer of 1950, the only species taken by the *Oregon* beyond a epth of 25 fathoms was *Penaeus aztecus*, the brown grooved shrimp, and this xploration primarily concerned that species. A few drags made inside the 25 thom line for purposes of comparison did produce some white shrimp *enaeus setiferus* and the pink shrimp, *Penaeus duorarum*.

The general plan of daily work while fishing on the *Oregon* is as follows: series of hauls is made. The catches and the conditions under which the atches were made are compared. The information is recorded following a andardized pattern. Even in this daily work an attempt is made to learn mething. For example, a pair of shrimp drags are made as identical as possible except for one variable, (e. g.) using a flat trawl for one and a balloon awl for its pair. The results, recorded in detail, make it possible to draw onclusions about a great many conditions as they affect fishing. It may be ossible, for example, to tell immediately which net produces the larger catch. t the same time there will be available a record of the exact location of the aul, the time, depth, weather and bottom conditions and so on. Later with ne accumulation of a great many operation records it will be possible to make omparisons of catches with respect to any of these variable conditions. Of ourse, useful conclusions will have to be based on greater numbers of trials or some kinds of variables than for others.

The work in the area described above revealed the presence of a substantial opulation of grooved shrimp not being fished by the commercial fleets. Nearly ll of the offshore boats working the area are equipped with sufficient cable to ork in depths of 25 fathoms but not deeper and the few boats venturing into ne deeper water had not encountered promising concentrations of shrimp. During the period from July through September the *Oregon* took large

brown shrimp in every night drag from 30 to 50 fathoms. No small shrimp were included in the catches and the sizes taken in general increased with depth. The largest shrimp, as large as 6 count, were taken in the deepest water and the smaller sizes, 10 to 16 count, in shallower water. During July and August the greatest concentrations were taken in depths of 38 to 40 fathoms, but after a storm at the end of August the heaviest concentrations were found in depths of 32 to 34 fathoms. Near the outer limits of the range, in the greater depths, fewer but larger shrimp were found.

The extreme limits of the range, where the largest shrimp (mostly females) occurred, would not be profitable to fish, but, in general, a part of this area contained consistently greater concentrations than were found inside the 25 fathom range.

The outer limit at which the brown grooved shrimp were taken was 54 fathoms. Few shrimp were taken in depths from 54 to 150 fathoms and these few were of non-commercial species. A total of four drags in 195 to 258 fathoms produced catches of some interest. Preliminary drags over bottom of unknown roughness have been made with a 40 foot flat shrimp trawl on a bridle to a single cable, and this rig was used in all successful drags in deep water. The trawl doors were provided with extra weight and the length of cable used was approximately 3½ times the depth. Shrimp were taken in each of these drags. The most abundant species by far was a red colored shrimp with very long antennae *Hymnopenaeus robustus*. When taken from the water these animals have the color and general appearance of boiled shrimp. In one drag of 45 minutes duration, 60 pounds of 28 count red shrimp were taken along with 61 pounds of scrap. This rate of capture compares favorably with catches of marketable shrimp made by the same gear in shallower water, where good concentrations of shrimp were found. In the deep water drags, a few specimens of other kinds of brightly colored shrimp were taken.

Although the emphasis in the past months has been on shrimp, data on other fishery items have been accumulated having possible future value. Continued observations of fish at the surface have been made. Black-finned tuna were observed at the surface, near the mouth of the Mississippi, over depths of about 50 fathoms. Spiny lobsters were taken with hook and line on rocky bottom near the continental shelf..

In future work off the coast of Texas, the *Oregon* will continue to concentrate primarily on the distribution of brown shrimp and attempt to locate concentrations of commercial value. A very interesting relation of temperature change to movements of this population has been suggested by the data collected so far. It is hoped to get more information on this problem during the future cruises.

Effect Of The Menhaden Operations On Other Fisheries

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The effects of menhaden operations on other fisheries has long been a point of argument, particularly among fishermen who know little about the menhaden

hery, and many exceedingly misleading statements have been made about e matter.

Most sportsmen and many commercial fishermen are wrongly convinced that:

1. Menhaden fishing is harmful to the spawning grounds of commercial and sporting fish and shrimp.
2. Menhaden fishing destroys large numbers of commercial and sporting fish and shrimp.
3. Menhaden fishing destroys the food of large numbers of commercial and sporting fish.

On the basis of present research, these statements, which will now be scussed in some detail, are almost entirely incorrect.

ffect of Menhaden Fishery on the Spawning Grounds of Fish and Shrimp

Briefly, the menhaden fishery has little or no effect on the spawning grounds the spawning of any of the common game or food fishes, or in commercial rimp.

Speckled trout and drum spawn in shallow grassy bays where purse seines e never used. Redfish spawn offshore in October and November, after the enhaden season is over. Spanish mackerel eggs are very tiny, having a iameter of from 1/22 to 1/28 of an inch. When discharged from the parent ey rise to the surface, where they float at the mercy of wind and tide until atched, hence any net would have little effect on their number, especially as ne female may discharge in excess of 1,500,000 eggs. Sheephead spawn along ndy shores of the Gulf during the summer. Their eggs are apparently pelagic, ence would be no more affected than those of the Spanish mackerel.

Shrimp, both red and white, spawn offshore, during the entire summer, and eir tiny eggs, smaller than grains of sand, immediately sink to the bottom, here they are untouched by the purse seine as it is generally used. Furthermore, the fact that one of our shrimp spawning grounds off Aransas Pass is eing constantly disturbed by the nets of the shrimp fishermen, with no apparent arm whatever, would point to the fact that such disturbances cause little amage.

The assertion by many fishermen that the very small shrimp frequently seen n the webbing of shrimp trawls and other nets are the young of the commercial pecies is incorrect. Microscopical inspection will disclose, in most cases, that hese tiny quarter-inch shrimp have egg masses on the outside of their bodies. They belong to the genus *Acetes* which carries its eggs in this manner. The commercial shrimp does not spawn at this size, and it carries its eggs within ts body.

Effect of Menhaden Fishing on Commercial and Sporting Fish and Shrimp

Interest in the effect of menhaden fishing on the adult population of commercial and sporting fish and shrimp has always been keen, as can be shown by an examination of findings from various locations where purse seining for menhaden is a common fishery. Space does not permit more than a brief review of this research at this point. However, those interested in the matter can inform themselves more fully by reference to the bibliography at the end

of this article. Smith (1896) found that in 1078 sets of a menhaden purse seine far less than one-half of one per cent of the fish taken were either food or game fish. Greer (1915) saw only eight mackerel and ten bluefish taken in one day's fishing in which 240,000 menhaden were caught. Filipich (1947) made surprise visits to various menhaden operations in Mississippi. In one boat which unloaded 70 tons of menhaden, *there was not a single game or commercial fish.* Eight boats inspected by him and a group of sportsmen had no game or commercial fish. Two boats unloading 70 tons of menhaden had one mackerel and six sand trout. That is, out of a total of eleven boats inspected, only one mackerel and six sand trout.

Simmons (1949) saw, in 62 days, during which 59 hauls of a purse seine were made, 42 bluefish, 3 drum, 7 flounders, 1 redfish, 77 sand trout, 10 mackerel, 2 speckled trout and 7 whiting. During these same sets 2,500,000 menhaden were taken.

Breuer (1950) saw, in 95 days, during which 143 hauls of a purse seine were made, 205 mackerel, 304 bluefish, 3 speckled trout, 242 sand trout, 8 whiting and 5 flounder.

Certainly such small catches of these fish are insignificant. Moreover, actual attempts to utilize the purse seines along the Gulf coast as a means to catch game and food fish, especially Spanish mackerel, have resulted in failure. Purse seining was tried unsuccessfully at Galveston a short time before the war, and a similar attempt was made at Grand Isle, Louisiana, in 1945. The Grand Isle attempt resulted in over $6000 loss to the operator (Gowanloch, 1949).

In the shallow water of the bays, which are the nursery grounds of most of our game and food fish, purse seines cannot be operated. In deeper water, where a set can be made, it has been observed that game fish enclosed in the net sound and escape below the lead line before the seine can be pursed.

Effect of Menhaden Fishing on the Food of Game and Commercial Fish

Since the "History of the American Menhaden," by G. Brown Goode, published in 1879, and republished in 1880, there has been little comprehensive material published on the menhaden. Goode's work was an enlargement of manuscript notes left by Professor Baird, based upon *opinions and information elicited by means of circulars to fishermen, manufacturers, custom officers, light keepers, etc., supplemented to some extent by observations of U. S. Fisheries agents, but not upon a scientific study.*

Goode himself admitted that it was found necessary to make allowances for many inaccuracies of statement on the part of his correspondents, and that some of them, having been unable to obtain exact information, had ventured to guess at what they did not really know from experience or research.

It is these theories of Goode and his correspondents that have in many instances been repeated by the uninformed and that have taken the place of actual knowledge until this day. This is particularly true with regard to the use and importance of menhaden as a food by other fish.

The list of fish enumerated by Goode (who has been quoted by Jordan and Evermann and the Encyclopedia Brittanica) as destructive enemies of menhaden does not comprise all the species that at times eat menhaden, *and it includes some not known to feed upon them at all.*

The assumption that they do is made partly from the fact that they are built on the model of predaceous fishes, and partly because they are sometimes caught on menhaden bait. The first part is to some extent justified, since it is safe to assume that a species which to any extent eats other fishes will eat menhaden if it can get them; but it is not safe to infer that it eats enormous quantities, as its habits may be such that it is not brought into contact with such numbers of menhaden, or food which it prefers may be present at the same time and hence taken instead of these fish. That a fish is caught on certain kinds of bait or that the bait is the most successful to use does not signify that the principal food of that fish is the bait used. Certainly fresh water black bass do not subsist on artificial flies and plugs, yet great numbers of them are caught on these baits.

Neither is it justifiable to assume that all of the predaceous fishes listed by Goode feed exclusively and daily upon menhaden, even during the time they are concurrently on the coast. Among fishes concerning whose habits we are well informed, it is known that they change their diet from time to time, and that there are periods of days when they do not feed at all (Kendall, 1910).

When the Texas Game, Fish and Oyster Commission undertook the present survey of the food of fishes, reference was made to earlier published scientific reports from this coast. There were only two of these.

The first of these was made by John C. Pearson of the U. S. Bureau of Fisheries, and in his results, based on 14 months of continuous field observations, he does not list menhaden as forming any portion of the food of trout, redfish or drum, the three main food and sporting fishes of the Texas coast.

Gunter (1945) did not find menhaden in the stomachs of either redfish or drum. He found trout eating menhaden in small quantities.

The third survey, that of the Texas Game, Fish and Oyster Commission, extended from June 7, 1948 to September 1, 1949. During this survey 26,005 fish were opened, and their stomachs analyzed. From these stomachs, only 581 menhaden were taken.

Included in the above total were 13,288 speckled trout, 3,137 redfish, 3,428 Spanish mackerel, 2,237 kingfish, 26 sailfish, 204 dolphin, 1 wahoo, 25 pompano, 77 ling, 28 jackfish, 27 bluefish, 9 jewfish, 1 warsaw, 374 redsnapper, 46 sheephead, 111 flounder, 75 tarpon and 647 gaff-topsail catfish. The balance were fish of neither commercial or sporting importance.

Space does not permit a complete breakdown here of the stomach contents. However, roughly speaking, 67 per cent of the food of all fish was shrimp; 30 per cent was scrap fish of the kind generally taken in shrimp trawls; 3 per cent was menhaden.

Shown below is a list of the more important stomachs analyzed and the numbers of menhaden found in them.

Species	*Number Analyzed*	*Number with Menhaden*
Trout	13,288	361
Redfish	3,137	9
Spanish mackerel	3,428	30

CONCLUSIONS

Because of the nature of the purse seine and the method by which it is used, purse seine operations cannot materially harm game and food fish in waters deeper than the maximum depth of the seine. Numerous investigations of all

types have shown that these seines do little harm to food and game fish populations. It is likely, by the same token that they do little good as a control for sharks. Seining operations have not materially lowered the level of the menhaden population. The production figures over a period of years, show a continuous and sustained yield, although it is possible that the catch per unit of effort may have dropped slightly because of the increased number of boats now in operation.

A total of 26,005 fish stomachs have been analyzed. Of these, 13,288 were speckled trout (*Cynoscion nebulosus*), 3,137 were redfish (*Sciaenops ocellata*), and 3,428 were Spanish mackerel (*Scomberomorus maculatus*). The balance were various species from the Gulf Coast of Texas. These fish were caught over a period of 15 months, from June 1, 1948 until September 3, 1949, during which period 3 separate stomach analysis projects were carried forward. The results tabulated from the three projects were in close accord with one another, and with the findings of two previous investigations.

Of the 19,583 fish examined belonging to these three species, 12,505 contained food, including the remains of 400 menhaden. The percentage of the 6,433 individuals of other species, besides the three named, that had included this species in their diet was roughly the same. They had eaten 181 menhaden.

In all five investigations dealt with in this paper, shrimp were found to be the preferred diet of the three favorite food and game fishes. The work of Knapp and his associates, of Miles, and of Kemp, established that, during their investigations, shrimp had been eaten by 60 to 70 per cent of all fish examined.

The fact that these projects covered and overlapped all seasons of the year is significant as establishing a positive trend in the diet of the species discussed. Trout, redfish, and Spanish mackerel do eat menhaden in small quantities, but do not necessarily search for them because they are a preferred food as is shrimp.

LITERATURE CITED

BREUER, JOSEPH P.—1950—*A report on the effects of the Port Arthur menhaden fishery on food and game fish for the period of June 6 to September 9, 1949, inclusive.* Rept. of the Mar. Lab., Tex. Game, Fish and Oyster Comm. for the fiscal year 1948-49: 84-93 (Mimeo).

FILIPICH, MECO—1947—*Report to the Mississippi Seafood Commission, Biloxi, Mississippi.* Menhaden Plants Report.

GOODE, G. BROWN—1879—*The natural and economical history of the American menhaden.* Rept. U. S. Comm. Fish. 5: 1-529, 30 pls.

GOODE, G. BROWN and W. O. ATWATER—1880—*A history of the menhaden with an account of the agricultural uses of the fish.* Orange Judd Co. New York. i-xii, 1-529, 30 pls.

GOODE, G. BROWN, and THEODORE GILL—1903—*American fishes. 2nd Ed.* Dana Estes and Co. Boston. i-lxviii, 1-562, 6 col. pls., many text figs.

GOWANLOCH, JAMES NELSON—1949—*Menhaden facts and fallacies.* The Advertising Publishing Co. Pascagoula, Miss. 1-26, 2 figs.

GREER, ROB LEON—1915—*The menhaden industry of the Atlantic Coast.* Appendix 3, Rept. U. S. Comm. Fish. 1914: 1-27, 7 pls.

GUNTER, GORDON—1945—*Studies on marine fishes of Texas.* Univ. Tex. Publ. Instit. Marine Science 1(1): 1-190.

HILDERBRAND, SAMUEL F.—1948—*A review of the American menhaden, genus* BREVOORTIA, *with a description of a new species.* Smithson. Misc. Coll. 107(18): 1-39, 9 figs.

KEMP, R. J.—1950—*Report on stomach analysis from June* 1, 1949, *through August* 31 1949. Rept. of the Mar. Lab., Tex. Game, Fish and Oyster Comm. for the fiscal year 1948-49: 101-127 (Mimeo).

KENDALL, WILLIAM CONVERSE—1910—*Effects of the menhaden and mackerel fisheries upon the fish supply.* Bull. U. S. Bur. Fish. 28(1): 279-293.

MILES, DEWEY W.—1949 (1950)—*A study of the food habits of the fishes of the Aransas Bay area.* Tex. J. Sci. (In press).

MILES, DEWEY WILLIAM, and ERNEST G. SIMMONS—1950—*The menhaden fishery.* Tex. Game, Fish and Oyster Comm. Publ. No. 2: 1-45. (In press).

PEARSON, JOHN C.—1929—*Natural history and conservation of the redfish and other commercial sciaenids on the Texas Coast.* Bull. U. S. Bur. Fish 44: 129-214, 44 figs.

ROY, LEONARD C.—1949—*Menhaden, Uncle Sam's top commercial fish.* Nat. Geog. Mag. 95(6): 813-823, 11 ills.

SIMMONS, ERNEST G.—1949—*Report on the menhaden fishery at Port Arthur.* Rept. of the Mar. Lab., Texas Game, Fish and Oyster Comm. for the fiscal year 1947-1948: 23-36 (Mimeo).

SMITH, HUGH M.—1896—*Notes on an investigation of the menhaden fishery in* 1894, *with special reference to the food-fishes taken.* Bull. U. S. Fish. Comm. 15: 285-302.

Control Of Fish Spoilage By Icing And Freezing

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THE AVERAGE PERSON who handles fish, from the fisherman on the boat to the clerk in the retail store, knows through experience, that in order to keep fish from spoiling, some form of refrigeration must be used. But it is probably safe to say that 80 per cent of the people who chill or freeze fish do not know why the lowering of temperature preserves the fish, or what a marked effect a few degrees change in temperature can have on the fish. Perhaps, if those concerned did know they would be much more careful with the icing and freezing operations.

The information given in this paper is not entirely new. It is known by a number of people but most of them are technologists—and technologists, themselves, handle very little fish. On the chance that some of this information may reach those who actually handle or supervise the handling of fish and shellfish, a brief description of the spoilage processes of fish at various temperatures will be given.

The principal causes of fish spoilage are bacterial action and autolysis. Although bacteria are extremely small and may be seen only with the aid of a microscope, they can produce almost unbelievable results. A single bacterium can do little by itself—the power of bacteria lies in their number, for they grow or multiply at an enormous rate. Bacteria grow not by becoming larger but by multiplication. Under ideal conditions for growth bacteria multiply about once every 20 minutes. At this rate one bacterium would produce 8 in one hour, 262,144 in 6 hours, and about 68,000,000,000 in 12 hours. This phenomenal growth of bacteria is probably the reason that prompted Dr. L. B. Jensen of Swift and Co. to state that food packing operations are likened to a race between the micro-organism and man to see who gets the food first. Unfortunately, there have been too many times when the microbes have won the race by an obvious margin, but the fish dealers have not conceded defeat. The secret of preservation is to make sure that favorable conditions for bacterial growth, such as high temperatures, do not exist.

Cooperating with bacteria in the spoilage processes is autolysis or self-

digestion of the flesh. Autolysis is simply the action of the enzymes of the living flesh which continue their work after the fish dies. When the fish is living, these enzymes are prevented from attacking the living cells but when the fish dies the protective system breaks down and the enzymes begin their softening action on the flesh. Bacterial action appears to be much more important than autolysis in the spoilage of fishery products.

Practically all foods contain bacteria, and many foods, such as meat and milk, may contain large numbers of them, but very few foods are in such an unfortunate position as fish.

First of all refrigeration, the one satisfactory method of keeping most food products fresh, is partially ineffective in the fisheries. Because the unusual types of bacteria which contaminate fish flesh are resistant to ordinary refrigeration temperatures, the "keeping time" of fish under non-freezing refrigeration is relatively short. For this reason it is necessary to take full advantage of all that is known about the preservation of fish by refrigeration.

In order to understand something about the unseen enemy we are fighting, let us trace briefly where these bacteria come from and how they attack the fish. Most of the fish-spoiling bacteria are brought into the packing plant on the fish itself. The heaviest concentrations are in the slime and in the entrails of the fish. Of course, other bacteria are picked up in the handling process from the hands of men, etc., but these are not too important for they grow very slowly under ordinary refrigeration. The bacteria of sea origin are much more hardy, for they are accustomed to living in cold sea water and can grow rapidly at temperatures not very far above freezing.

Knowing where the troublesome bacteria come from the next problem to be solved is to determine how they attack the fish and in what areas. On the skin surface and in the entrail cavity of fresh fish there are millions of spoilage bacteria but the flesh itself is sterile. The maximum bacterial growth is in the lining of the entrail cavity and in the blood vessels under the backbone. If there is a break in the skin or the cavity lining, the bacteria will quickly invade the flesh. But even though the bacteria may not penetrate the flesh, they still can spoil the fish by producing an objectionable, strong, fishy-smelling substance, such as trimethylamine, which easily diffuses into the fish flesh or muscle.

If the spoilage bacteria can grow at refrigeration temperatures, how can we control spoilage? Through work which has been carried out by Castell in Canada, we know that the temperature at which fish are stored is very important. For most common foods, storage at 37° F. is almost as effective as storage in crushed ice at 32° F., for the bacteria present will not grow at either temperature. With fish this is not the case. Experiments have shown that cod fillets stored at 32° F. kept twice as long as fillets stored at 37° F.—twice the "keeping time" with a mere five degrees change in temperature. This would not be important if fishing boats and plants carefully iced their fish in plenty of finely crushed ice, but unfortunately this is not always the case. Temperatures higher than 35° and 40° F. are not uncommon for iced fish in the hold of fishing vessels. Ice will bring the temperature of fish down to 32° F. or below, but to obtain these temperatures care is required in packing the fish in ice. A shovelful of ice on top of a box of fish is not sufficient. The fish must be surrounded by ice. According to a British scientist who is now working on the preservation of fish in ice, temperatures as low as 26° F. may be obtained if the fish are properly iced. He found the average temperature to be between 30° F. and

° F. These results have not been verified.

This brings us to the freezing point of fish, that is, 25° to 28° F. Below is temperature our problem changes somewhat. As in the non-freezing temrature range the bacterial spoilage processes continue to slow down as the mperature of the frozen fish is lowered, but other problems appear. First of ., much more is expected of frozen fish than of iced fish. Instead of aiming at keeping time of several days the frozen fish are expected to keep for many onths. From the results of experimental work and from practical experience is known that in order to maintain quality in frozen fish a storage temperare of 0° F. or lower must be maintained, and the lower the storage temperare the better the fish. Fish stored at -20° F. will be of noticeably higher ıality than those stored at 0° F. Unfortunately, many of the present comercial freezers are not equipped to maintain temperatures economically as w as -15° F. to -20° F. However, there is now a general trend in designing ew frozen storage warehouses to provide for these low temperatures.

Not long ago there were two generally accepted theories regarding the freezg of fish. One was that the speed of freezing is the most important factor in aintaining the quality of frozen fish. The second was that one of the principal auses of deterioration in frozen fish during storage is fluctuation in temperare. Both of these theories have now been cast aside. In regard to speed of eezing, it was believed that the more rapid the freezing the better the product, ecause the small crystals formed by fast freezing would not penetrate the ell walls. It was reasoned that the large ice crystals which formed during elatively slow freezing punctured the cell walls and freed the juices which aused "drip" on thawing. Research has shown that the temperature of storage far more important than the rate of freezing. In regard to fluctuating temeratures there is now evidence that the quality of frozen fish is dependent on ne mean storage temperature, and that the main disadvantage of a fluctuating ncrease in temperature is to increase the mean temperature. Of course high torage temperatures, that is, above 10° F., should always be avoided because f the relatively rapid rate of deterioration. Although it has been shown that ne rate of freezing is secondary to the storage temperature, some care must e exercised during the initial freezing operation. First, if the freezing is too low large ice crystals may form and make the product unattractive when hawed for cooking. Even more important is the possibility that a relatively varm freezer temperature may permit spoilage of the fish before the actual reezing takes place. There have been numerous instances where spoilage of arge lots of fish has occurred in the freezing rooms. In some cases this has been aused by overloading a freezer room with warm packaged fillets, the packaging naterial acting as effective insulation against the cold air of the freezer.

Part of the trouble experienced in the frozen fish industry of the U. S. is aused by the practices of using the freezers as a means of "saving" the "not too resh" fish. The fish which are landed when strictly fresh are the ones which re sold in the fresh market, while fish of lesser quality often go to the freezer. This seems to be a logical step, for the producer realizes that the amount of ime required to get fresh fish to market and to the consumer is much greater han the time required for the same fish to reach a safe preservation temperare in the freezer. What he may not realize is that the quality of frozen fish s directly dependent on the condition of the fish when frozen. If the fish are of questionable quality when they go in the freezer they will be even worse when they are removed and thawed. If a fish producer intends to build or

maintain his frozen fish business on quality he will freeze only strictly fresh fish. Very few realize that one of the regular phases of deterioration of quality in fish is loss of flavor. During this phase the fish appears fresh for the flesh has no off flavor or odor, in fact there is practically no odor at all, but the sea-fresh flavor and odor are gone. In this stage many people condemn the species as being tasteless, not realizing that they are eating poor quality fish.

The Fish and Wildlife Service now has underway a project by which it hopes to devise a means of enabling the fishing industry to market "sea fresh" fish and fish fillets. It is referred to as the "Freezing-fish-at-sea" project. Laboratory and pilot plant tests have indicated that it is possible to freeze strictly fresh fish in the round at sea, bring them to port and hold them in frozen storage for a period, then remove the fish from storage, thaw and fillet them, package the fillets in the usual manner and refreeze them. To test the method under commercial conditions, the Service has obtained a New England trawler. One-half of the hold of the vessel will be heavily insulated and freezing equipment will be installed, the other half of the hold will be used for icing down the fish, as is now practiced, in order to compare the quality of the frozen and iced fish and to get information on the cost of the two methods. If the freezing-at-sea process can be successfully worked out it will have many advantages over the present methods. First, there will be no question of freshness, for the fish will be frozen almost as soon as they come from the water. At present there is some question about freshness because fish caught by New England trawlers must be held in ice as long as 8 to 10 days before being filleted. The distance of the fishing grounds from the filleting plants makes it impossible to land all fish in less than this time. The second advantage is that the vessel can remain on the fishing grounds until it has a full load of fish. Third, the liver and all other material now discarded at sea will be brought ashore, in perfect condition for conversion into by-products and pharmaceuticals. Fourth, the shore plants and labor will be able to operate on a fixed work schedule since the round fish will be drawn from the freezer as needed. This will eliminate the troubles caused by the glut and slack seasons which now occur each year. Above all, however, is the advantage that all the fish and fish fillets produced by this method will be of uniform high quality.

It is realized that in this paper many important phases of freezing of fish have not been mentioned, such as glazing, dehydration, and oxidation problems with oily fish. Time does not permit a complete discussion of all methods but it is hoped that the few points on the icing and freezing of fish which have been discussed will help someone to improve the quality of the fish he produces and thus help both his own business and the entire fishing industry.

LITERATURE CITED

CASTELL, C. H., 1949. (Atlantic Fisheries Experimental Station, Halifax, N. S.) Fisheries Research Board of Canada, Progress Reports of Atlantic Coast Stations, No. 44, 8-1

The Use Of Echo Sounders In Fisheries

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SINCE THE EARLIEST KNOWN TIMES man has been interested in fish, and for almost as long he has taken fish commercially. The tools of the commercial fisherman have changed little in recorded history. True, bone hooks have long

ince been replaced by steel, and fabric netting has in some cases given way o nylon, and elbow grease has in some cases been replaced by powered net oists; gasoline or diesel engines for motive power have replaced oars and ails—not alone in fishing boats, and automatic power reels have been introluced to aid the deep water line fisherman. But of all the advances in the isheries industry the most outstanding has been the introduction and use of cho sounding gear.

Echo sounding gear has given the fisherman new eyes, eyes that see through vater, clear or cloudy, to depths once called unfathomable. "Under-water Radar," "Electronic Fish Finder," "Under-water Road Map," these are only a ew of the familiar nicknames given to this equipment by fishermen. The praise given to echo sounding gear by fishermen is well deserved, as this gear is evolutionizing the methods of operation of almost all types of commercial ishing. Fishermen throughout the world, cautious in accepting new ideas, are ow demanding echo sounding gear in such quantities that manufacturers are ard pressed to meet the demand. For a thorough understanding of the imortance of this revolution it is necessary first to understand the principles of cho sounding as now employed.

Echo sounding is literally the function of measuring the depth of water by means of echos bounced off the bottom and timed in their passage. The equipment to accomplish this could be, and once was, simply a sound-making device, plus a stop watch or other timing mechanism, and a sound amplifier for reception of the echo. The sound employed for this purpose may be of any frequency within the audible or superaudible range. Years of research and practice, however, have shown that frequencies of from 20 to 50 thousand cycles per second are best suited to this purpose. Sound frequencies within the sonic and ultrasonic range have the characteristic of traveling at essentially the same speed in a given medium, and of being effected little by changes in the salinity or temperature of the water. Actually, large changes of salinity or temperature of the water do cause minor variations in the speed of sound. The speed of sound in any liquid is given by the relation: velocity in meters per second = the square root of k/p. Where k is the adiabatic bulk modulus of elasticity, and p is the density of liquid. In fresh water at a temperature of 8°C this velocity is 1427 meters per second or 4,681.7 feet per second. In sea water at 35 parts per thousand salinity the relation becomes: velocity in feet per second equals 4,756 $(13.8\ t + 0.12t^2$, where t is the temperature of the water). At 8°C the velocity from this relation is 4858.7 feet per second. It will be noted that the difference in velocity between fresh water and sea water at the same temperature is small enough to be of interest only to surveyors and of no importance to the commercial fisherman. As most echo sounders are designed for use in sea water, and not provided with compensators for changes in density or temperature, the maximum error of approximately 177 feet per second (only 3.6%) is encountered only by the unusual fishing boat which may operate in both sea water and fresh water. Incidentally, some time ago a rumor was circulated to the effect that the energy emitted from some echo sounders was harmful or disturbing to fish. This rumor was without foundation. In fact, there is conclusive evidence that fish are oblivious to energies of the strength and frequency emitted by most such machines.

Present day mechanisms for producing the sound, timing the passage and receiving and indicating the echo are generally combined into a single unit system. The timing, which is the heart of the mechanism, is accomplished by

means of a constant speed motor which carries the transmitter keying contact, and some means for producing an indication of the echo and relating the time of reception to the time of transmission, along a graduated scale. An indicating echo sounder commonly employs a revolving disc to which is attached an electric lamp. At the zero position of the disc, the transmitter is energized and the sound is emitted from the under-water soundhead, or oscillator, mounted in the hull. When the echo is received and amplified it causes a flash in the electric lamp which has meanwhile been rotated to an angular position corresponding to the elapsed time. The indicator is so constructed that the flash of light from the lamp is immediately comparable to a graduated scale, marked in units of depth, so that a direct reading of depth is obtained. To obtain maximum benefit and utility from such an indicator it would be necessary to observe the flashes continuously and to record the data thus obtained in the form of a graph. This would require two operators, one to observe and one to record. For this reason the depth indicator has limited application except for purely navigational purposes, as a single operator finds it impossible to observe the indications continuously and to visualize the true contour or other characteristics of the surfaces from which echoes are received.

A recording echo sounder employs the same basic principles as the indicator type, but produces its data as a permanent (or in some machines semi-permanent) mark on a graduated chart, thus doing automatically and instantaneously the complete job which might be done by an indicator and two efficient operators. The recorder completes the job started by the indicator, and produces a complete picture, in profile, of the bottom contour, or of the size, shape and density of any reflective matter between the surface and the bottom. There is importance in this last statement, as it is from this ability that the name "Fish Finder," and a whole new field of application, has arisen.

The balance of this discussion is concerned with recording echo sounders only, and all technical details and references to actual applications and installations refer to the Ultrasonic Depth Recorder, as manufactured by the Bendix Aviation Corporation.

The Bendix Ultrasonic Depth Recorder produces its record on dry graduated paper by means of a moving wire stylus, through which the amplified echo is passed to remove, electrically, the light gray coating from the surface of the record paper so that the black of the graphite-bearing paper bulk shows through. This system avoids the disadvantages of inking pens and wet paper. It has the further advantage of producing a detailed record, as the amount of surface coating removed is dependent upon the strength of the echo which, at a given depth, is dependent upon the hardness and compactness of the bottom or other reflective surfaces. The sonic energy has the ability to penetrate most matter to a greater or lesser extent, and echos are obtained from the depth of the penetration, descending in strength with the depth of penetration. Thus, by darkness of initial echo indication and by the fine degrees of shading resulting from the penetrating energies, the record produced gives an accurate indication of the hardness, or compactness of the bottom. It is, therefore, possible to distinguish between rock, sand, and mud, and, with some experience and familiarity with the minute peculiarities of the particular machine, to go further and determine the approximate consistency of mixed bottoms, or to detect small patches of harder material embedded in soft mud or sand, etc.

As a navigational aid the Depth Recorder is extremely valuable. By following the contour of the bottom, grounding and stranding may always be avoided, and

comparing the record graph with navigational charts, pin point positioning y be obtained. Thus a Depth Recorder may be considered a necessity for igating shoal waters, particularly in uncharted areas, or areas unfamiliar he boat's navigator. The bottom contour is shown in great detail, the pres- ation of bottom irregularities being most faithful, and dependent only on the nber of soundings per lineal unit of bottom covered, and the scale range of recorder being used. For the utmost in accuracy, the recorder used should e the maximum possible number of soundings per lineal unit of bottom ered, and should have a scale range not exceeding the maximum depth of rest, so as to obtain greatest enlargement of contour. Reference to sound- s per lineal unit may be misleading, as this will actually depend only upon lineal speed of the boat. The rate of sounding is limited by the scale range, sufficient time must be allowed between the soundings for passage of sound m the soundhead to the bottom and return, and for recovery of the elec- nic circuits. Thus, soundings cannot be emitted more frequently than given the relation: soundings per second $= v/2d$; where v is the velocity of the nd and d is the depth in feet. Assuming a nominal velocity of 4800 feet second, it may be seen that for a depth range of 400 fathoms, soundings not be taken more often than one per second, as it would take approxi- tely one second for the sound to travel to the bottom and return. Actually recovery time of electronic circuits, the necessity for avoiding any possibility over-lap, and certain mechanical consideration, dictate that soundings be en at from ¼ to ½ of this maximum rate. As the lineal distance traveled the boat between soundings may be sufficient to result in a serious loss of ttom detail, it is important that the boat be held to a low speed when ultimate bottom detail is required. For average use, however, depth recorders have n designed to give sufficient detail at average boat speeds of from 8 to 15 les per hour.

As has already been mentioned, the depth recorder has the ability to detect d present the evidence of any reflective matter suspended in the water between soundhead and the bottom. Thus, heavy masses of seaweed or suspended bris may be detected, and, most important to fisheries industries, schools of n may be detected. There is much which is not yet known about the abilities various materials to reflect sonic energy, but these things have been termined by actual experience. Light or occasional patches of under-water getable growth will not be indicated. Sponge and live coral will not be tected, unless in growths of considerable mass. Wrecks, whether of wood or el, will be detected, with steel generally producing a much stronger echo. lagic fish, either at surface or in deep water, will be detected, and the pene- tion of the sonic energy into the school will provide an immediate indication the density and/or thickness of the school. These functions have brought depth recorder to a position of prominence in fisheries operations, to the tent that this equipment is now becoming standard on most new boats, and being installed on thousands of older boats.

Many types of fishing are dependent upon the knowledge of the ocean's ttom, and conditions existing thereon. Fish may be attracted by the vegeta- n to be found at various depths and on various types of bottom, and many ecies are found only where certain bottom conditions exist. In years gone by, e location of these so-called fishing "banks" was often a closely guarded family company secret. Usually the banks were found by pure chance, or by the udy of hydrographic charts. These methods have now been supplanted, in

many cases, by the use of echo sounding electronic devices, which have revolu tionized the commercial fishing industry. The guesswork has been partiall taken out of "prospecting" for new fishing grounds. With a depth recorder th master of the fishing vessel can accurately locate the fishing banks. Many of th secrets of by-gone generations are now available to progressive fishermen, i their vessels are equipped with a depth recorder.

All types of fish that school closely and at not too great depth, such as tuna sardines, mackerel, herring, and anchovies, are taken with purse seines. Thi method consists of encircling a school of fish with a net that hangs verticall in the water, supported at the top by corks and held down at the bottom b weights. When the fish are completely encircled, the "purse" line is drawn closing the net at the bottom end, making escape for the fish virtually impos sible. Purse seine nets range in size up to 1800 feet long, and 180 feet deep Once a school of fish has been located, the purse seine captain must determin the depth of the water, and whether or not there are obstructions on the botto that would damage his net.

Before echo sounding equipment became available it was often necessary t sound by hand before proper pursing of the net. Frequently this hand-soundin method did not reveal the presence of jagged pinnacles or other obstruction with the result that nets were sometimes torn or completely lost. With a dept recorder, it is now possible, not only to locate fish and to estimate closely th size of each particular school, but also to know exactly the bottom conditio that will be encountered during the seining operation. With the large pur seine nets being valued as high as $18,000, it becomes readily apparent that depth recorder appeals to the fisherman as most valuable insurance again damaged gear, as well as a profitable aid in making bigger catches.

Many species of fish, such as sea bass, salmon, shark, and others are tak by the use of gill nets. The nets themselves consist of webbing, with the me size depending on the size of fish desired. Sections of net are strung in plac where the fish are known to feed or to pass. The position of the nets is perpe dicular to the bottom, and usually placed in a series. The nets are suspend with floats along the top, and weights along the bottom and are held in anchors or allowed to drift with tidal or river currents. Their position indicated by floats and flags on the water's surface. The fish are caught swimming into the open mesh. Unable to swim through the mesh, the fish to back out and the mesh catches in the gill cover.

The proper location of gill nets is important. Frequently the gill net fisherm finds that by placing his nets along the edge of a ledge at a certain specif depth his catches are considerably larger than if the nets are placed along flat bottom. Before depth recording was available, it was necessary for gill net fisherman to take accurate shore bearings so that, in letting out his along a ledge, he did not drop part of it off into the deeper water. Where p visibility made shore bearings impossible, the successful placement of his n was dependent on luck. With the use of the depth recorder, it is now possi for the gill-netter to determine exactly where a ledge is and in which directio runs, regardless of visibility. The recorder enables him to spot his gear n the edge of the ledge, and to know that when it goes down it will be where wants it.

Trawling is performed with a net that consists of two wings and a "sa which is dragged along the ocean's bottom, scooping up the fish in its p The mouth of the net is held open by otter boards, to which are attac

dragging cables. The net is held in proper position by floats affixed to the and leads to the bottom. This type of gear is utilized for the taking of all es of bottom fish and has become standard in the shrimp industry. Trawling rations, perhaps more than any other, demands an accurate knowledge of bottom, as the trawling net is usually dragged at a speed of from 2½ to 5 ots, and must be conducted over a reasonably smooth, unobstructed bottom. ger trawl nets may cost as much as $5,000, and the normal wear and tear trawl nets is high. For this reason it is often considered economically un- nd to fish where unknown bottom conditions exist. Serious damage or loss of s, coupled with the loss of time involved, can make this type of fishing y unprofitable.

With the depth recorder, the trawler captain can now "see" his way over the tom, avoiding obstructions and fishing in areas most likely to be productive. experienced user of the recorder can frequently detect the presence of fish eral minutes before his trawl reaches them, and, if necessary, he can change course so that his net will pass through the heaviest concentration.

Fishing by set lines or long lines is of great importance. The set line gear nsists primarily of a long main line with leaders (to which the hooks are ached) fastened to the main line, at intervals. The main line is strung out ng the bottom and held in place with anchors at each end. Marker buoys on surface indicate the position of the anchors. The hooks are baited.

This fishing is applicable to all types of bottom fish, and was the method ed initially in the taking of shark, for which such a large market developed ring World War II. It is of importance to the fisherman to know what the ttom conditions are before he drops his gear. Without recording equipment et line fisherman may let out a string of gear only to find that only one-half the line has actually "fished" for him. The set line fisherman equipped with depth recorder reduces his number of non-productive sets.

Live bait fishing is used in Southern California by tuna boats. The method used to catch tuna which frequently move at a speed that makes netting them practical. Migratory schools are attracted by "chumming" with live bait, and en by fishing with hook and line from individual poles, much as the sport herman does. The securing of a supply of live bait, is sometimes as hard as tching the tuna themselves. These vessels are equipped with large bait tanks, rough which there is constantly circulated fresh sea water.

The bait fishes are caught in small purse seine nets from launches (usually rried aboard the mother vessel) and the bait is then kept alive in the bait nk. When the tuna are located, the chumming is started. Live bait thrown to the water attracts the tuna to the boat, where they strike at nearly any- ing moving in the water. Feathered jigs are then substituted for the live bait oks and the tuna are pulled aboard.

Echo sounding equipment aboard the tuna clippers can aid materially in the cation of off-shore banks where the tuna occur. The depth of water is some- nes too great to be sounded by the old lead line methods. Echo sounders are nployed to do the job much more efficiently. In addition, tuna clippers have cently begun to use echo sounding equipment to assist them in finding the hools of bait. This equipment is repeatedly paying for itself in the hours nd sometimes days of time saved in securing bait.

The use of echo sounding equipment in shrimp fishing is described in an ticle entitled "Shrimping Electronically," written by Mr. R. P. Geddes, Jr. of

the Bendix Aviation Corporation and printed in Pacific Fisherman in June of 1947. Parts of this are quoted:

"Extensive tests just concluded show the application of echo sounding to the problem of locating schools or beds of shrimp. The tests were conducted in the Gulf of California near the mouth of the Colorado River aboard a vessel engaged in actual shrimping operations.

"On March 5, 1947, a Bendix Model DR-3 supersonic depth recorder was installed aboard Fomento Maritimo's *El Padre* at Guaymas, Mexico. The unit selected for the tests was a standard depth recorder taken from the assembly line of the Bendix plant, in North Hollywood, Calif.

"The purpose of the trip to the Gulf of Lower California was to determine whether or not beds of shrimp could be located with the machine. At the time of the writer's visit in Mexico, shrimping operations of the Guaymas fleet were being conducted at the head of the Gulf of Lower California, in water ranging from 20 to 30 feet in depth. It was therefore decided that during the long run from Guayamas to the head of the Gulf that experiments would be made in an attempt to locate shrimp in deep water, it having been the contention among old fishermen that shrimp had been taken in deep waters years ago by the Japanese when they had the exclusive concession to these waters.

"However, efforts towards this end were unrewarded and the *El Padre* proceeded to join the fleet. Immediately upon arriving on the "grounds," dragging operations were commenced. The first three days of fishing brought little more than manta rays and fish commonly known on the west coast of the United States as "tom cod"—the lack of shrimp being attributed to the full moon.

"During all of the dragging operations of these first three days the recorder was in constant use and it was interesting to note that the only break in the monotony of the flat bottom line appearing on the chart was an occasional mark caused by the reflection of the signal from one of the mantas.

"Due to the shoal water, the Bendix was operated entirely on "foot" scale. When operating on this scale, 288 soundings per minute are made, or at the speed of five knots, a sounding was being made every 1½ foot of the bottom.

"On the fourth day of the tests, an entirely new mark began to appear on the chart—a mark that was in the bottom line.

"Due to the extremely soft bottom encountered, the bottom line was approximately ¾" in thickness. This condition was caused by the signal "mushing" into the bottom rather than bouncing back clearly as it would from a hard bottom. This new mark appearing within the confines of the "bottom line" was at first spasmodic, but as the day wore on it became more and more frequent. At the conclusion of the first drag of the fourth day of operations it was found that a small quantity of shrimp had been caught. Succeeding drags rewarded the crew's efforts with increasing amounts of shrimp. It soon became apparent that some connection existed between the new heavier mark appearing on the chart and the shrimp that were being caught. Experiments were then instigated to endeavor to find a definite tie-in between these marks and the shrimp.

"Buoys were thrown overboard simultaneously with the appearance of the mark and a close watch was kept on the dragging cables as the net approached the buoys. In each case, perceptible tightening of the cables took place as the net came abeam of the buoys. From this observation it was apparent that the net was encountering a material denser than the mud in which it was being dragged. Charts were made up on which all of this information was entered, and the figures thus tabulated proved conclusively that these darker lines appearing

ithin the confines of the bottom line were actually shrimp buried in the soft ıud. The shrimp being of greater density than the mud about them, they re- ected a sharper signal, and therefore a darker and more precise line appeared n the chart. One drag of 36 minutes duration was made that netted 2200 lbs. of ırimp. The chart made during this drag showed an almost continuous "darker" ne, and it was observed that during the entire drag, no slack appeared in the ragging cables.

"These findings of course were met with great interest from all of the ob- ervers. If this instrument could actually detect the presence of shrimp it would ıean many hours of futile dragging saved each day; it would mean hundreds f dollars saved in wear and tear on gear, plus additional hundreds of dollars ıved in operating costs to the boat owner.

"Here, indeed, was the dream of all shrimp fishermen—an instrument that ould *see* shrimp.

"It is still too early to make the statement that the Bendix Recorder will "see" hrimp under any and all conditions, but it is a substantiated fact that under onditions encountered on the initial tests locating and charting schools of hrimp electronically has become a reality. Further tests are being conducted in n effort to prove further that shrimp can be located with such an instrument ı this manner."

It is fully appreciated that not nearly all of the important aspects of the use f echo sounders in fisheries have been covered in this paper. Almost daily ntirely new applications or variations of older applications are being discovered nd the writer is incapable of keeping currently abreast of these new develop- ıents throughout the world. The principal applications and considerations ıave, however, been discussed and it is hoped that this discussion will provoke hought which may lead to the discovery of new applications in this area.

The Role Of Exploratory Fishing In The Development Of Commercial Fisheries

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All existing commercial fisheries have been discovered and expanded by :xploratory fishing, performed either by private fishermen in the normal course of their business or by exploratory work of various governments. In established ïsheries the pattern of development is a gradual exploration over increasing distances paralleled with the development of equipment suitable for developing he fishery. Eventually, the expansion is stopped either permanently or tem- porarily by the range of species and its ability to stand the drain of exploita- ion, by the limitations of standard fishing equipment and aids, or by the economics of production and marketing considerations. Many of our present ïsheries have reached or are approaching one or more of these limitations.

For economic reasons commercial fishermen seldom make a bold jump to new areas remote from markets or make radical changes in equipment unless here is assurance that profitable fisheries are available for development, or hat changes will add to their income. Pioneering in the fields of exploration and he development of superior equipment is expensive and usually beyond the means of the relatively small fishing enterprises. It must in part be a function

of Government if we are to expedite the expansion and improve the economy of our fisheries.

The objectives of exploratory fishing are to discover new and valuable fishing grounds, to devise effective methods of developing them and to establish practical fishery knowledge on which potential operators may base a sound decision on their utilization. The fishing equipment and effort must be of commercial proportions to enable potential operators to estimate the probable returns from a commercial venture.

Many years of commercial fishing have demonstrated that a concentration of effort on certain favored spots is required for profitable trips. Commercial fishermen also find that prolonged and indiscriminate running frequently ends in unsuccessful trips. Furthermore, the appearance of fish in a catchable state is an intermittant occurence even on favored spots and during the proper season. Exploratory efforts must, therefore, be concentrated in promising areas over an extensive period of time or the apparent conclusions may be greatly in error.

Development of the Pacific Halibut Fishery

The north Pacific halibut fishery is an example of one that was explored and developed by private enterprise.

The primitive Indians are presumed to have used halibut ever since they came to the Pacific and early explorers found them at various points along the coast from Washington to the Shumagin Islands. Explorations by the Bureau of Fisheries steamer *Albatross* in 1888 found halibut along the Aleutian Islands, Bristol Bay and a "scattering" around Middleton Island, Kodiak Island and the Shumagin Islands (1). This is a case of exploratory fishing effort spread too thin resulting in erroneous observations in the light of subsequent developments.

Prior to the completion of the railroads to the coast in the period from 1887 to 1893, the halibut fishery was chiefly exploited for local consumption and the greater part of the catch came from nearby inside waters, now barren. Difficulties were encountered in opening trade with the East but halibut on the Atlantic banks were becoming scarcer causing larger dealers with better trade connections to become interested in Pacific halibut (2).

The development of the halibut fishery until 1910 was one of progressive location and exploitation of grounds in the more or less sheltered waters of Puget Sound, British Columbia, Hecate Strait and the banks off Vancouver Island. Since the earliest vessels were sailed, excessive delays were experienced in reaching market. In 1893 the first powered vessel entered the fishery using round bottom boats for fishing which had to be towed to the grounds. A great advance was made in 1895 with the introduction of dories which could be nested and carried aboard the large vessels in bad weather thereby eventually opening the way for a transition to a high seas fishery. According to first opinion the supply of halibut in Alaska was small, and in 1903 Moser of the Bureau of Fisheries, believed that the halibut banks were principally on British Columbia and there was little prospect of a large commercial fishery in Alaska. However, great offshore banks were awaiting discovery (3).

Until 1910 the process of development had been based on exploration for new banks, their successive exploitation and partial depletion. However, the evolution of the fleet and more efficient fishing methods maintained production. By the use of dories the vessels could proceed to open waters, but fishing under

:se conditions rendered impractical the transfer of fish by hand to the ›ther vessel. Finally, in 1902, a net was devised and placed on the bottom the dory whereupon the entire catch could be lifted aboard at once by wer. This seemingly simple improvement permitted the catching and hand- g twice as many fish per day and illustrated the minor mechanical things on ich a great fishery depends (4).

The year 1910 marked the beginning of an important era in the fishery, for vately owned, able deep sea schooners were being introduced to compete th company owned steamers, reliable gasoline and distillate engines were ailable, mechanical developments were made, and the shift to deep sea hing began. From 1911 to 1913 the building boom for schooners reached peak and the fishery was extended offshore along Southeast Alaska to kutat, banks had been found near Prince William Sound, and to the south, nks were discovered off Oregon. Significantly, Thompson states, "Here as ewhere demonstration of the mere presence of fish was not sufficient for e best fishing spots and seasons had to be learned from experience" (5).

From 1915 to 1923 new banks were not eagerly sought but methods were adily improved enabling the fisherman to prosper on only a fraction of their rmer yield per unit of gear. Electric lights were introduced, enabling fishing roughout the long winter nights of Alaska. Cable anchor winches permitted chori ng on banks, better pilot house control of the engine facilitated hauling ar, dories were lifted aboard by power and electric lights were developed r buoys marking the gear. A most radical change on the schooners was the velopment of long line fishing in 1913, eliminating the need for dories. The es were set over a chute on the stern and hauled over rollers on the side by power driven gurdy instead of by the hand-hauling methods of the dory. The ng line allowed a greater freedom, for the gear could be set as convenient ver long distances instead of in a block, as was necessary for safety of men the dories, and fishing in stormy weather became possible. Prior to 1914 arly all halibut fishing was done from dories but in 1928 93 percent of the ar was operated by the long line system and dory fishing was finally made legal because it was best suited for shallow waters where small fish pre- minated (6 & 8).

By 1920 the Diesel engine had reached a high degree of perfection and the fusal of the oil companies to market low priced distillate fuel stimulated its doption. By 1923 many installations of powerful Diese's were made, for they ould be operated at higher efficiency on low cost fuels, resulting in the pos- bility of longer cruises and the reduction in fire hazard. As the schooner eveloped in efficiency, these privately owned, more economically operated oats displaced the company owned steamers (6).

The period of 1923 through 1928 was one of intense exploration and xploitation of the banks off central and western Alaska. At that time there as a seaworthy fleet propelled by powerful Diesels which could run long istances very economically, and techniques had been developed whereby 0 to 25 miles of gear could be periodically set and hauled over a distance f 50 to 75 miles in a day. As was the case with older banks, those west of ape Cleare had been known from early days and attempts had been made to sh them long before their real exploitation began. However, it was not until 923 that exploitation of the distant banks was begun in earnest by large chooners. New banks were progressively explored and exploited further to he westward until, in 1928, the first halibut from Bering Sea were landed.

Of parallel importance to the development of fishing areas was the periodic construction of cold storage plants at strategic locations along the coast. The encouraging effect of such facilities in promoting the exploration for new banks are obvious for a poor trip could be sold and the vessel re-outfitted for another trip (7 & 9).

As a result of depletion of the fishery a treaty was signed with Canada in 1923 imposing a closed season of three months in the winter, and in 1931 a seasonal limit on the catch was imposed by the International Fisheries Commission created under the treaty. In 1932, because of the depression, voluntary action was taken by the fishermen to spread the catch over the season and stabilize the market (10, 11). Most fisheries on the Pacific Coast are seasonal and many boats from other fisheries, together with an increasing Canadian fleet, participated in the halibut fishery, resulting in a progressively shorter season. In 1942 changing economic conditions and apportunities in other fisheries resulted in abandoning the curtailment plan (12, 13, 14). In 1929 the local fishery extended over a period of 9 months but in 1948 the catch limit was taken in only 32 days (15).

Development of the Alaska King Crab Fishery

The American fishery for Alaska king crabs is an example of one acquiring its start solely because of explorations by the Fish and Wildlife Service. About 1930 Japanese crab canning activities were extended across Bering Sea to the southeast side, and eventually into Bristol Bay, and in 1940 alone four factory ships took in excess of 8,000,000 crabs. For several years prior to 1940 occasional small American packs were put up in Cook Inlet, and in 1938 a floating cannery operation was attempted, without financial success, for the necessary exploratory work soon exhausted the limited capital of the enterprise. Increasing exploitation of a fishery by the Japanese in waters adjacent to Alaska raised serious questions as to whether American interests were making adequate use of domestic fishery resources. Initial inquiry disclosed that lack of knowledge of areas of abundance, methods of taking and canning king crabs and the fear of not being able to compete with the low Japanese costs of production were primary obstacles retarding development. Since the cost of the necessary exploration work would be prohibitive for private enterprise, Congress authorized the Service to make the study in 1940 (43, 42).

The explorations established the presence and seasonal locations of a large king crab population in Bering Sea, and lesser, but commercially exploitable quantities, on the south side of the Alaska peninsula. By the use of commercial scale gear the work disclosed when, where and how commercial catches of crabs could be made and discovered large quantities of bottom fish. Explorations by the Service during 1949 in the northeast portion of Bering Sea found that crabs and fish were present but widely scattered, and did not compare in apparent abundance with that in the southeast portion of the Sea. Bottom temperatures and depths also appeared to have a marked influence in the catch (45, 46).

Exploitation of this resource was delayed by World War II but the encouraging results of the explorations caused the captain of one of the exploratory vessels to build a boat in 1945 suitable for the fishery. In 1946 this and another vessel owned by a company organized to exploit Bering Sea started the commercial fishery, and in 1947 the value of their catches was greater than the cost of the explorations (49). In 1948 a federally owned factory ship

operated under contract by a private company, entered the fishery and received over 387,000 crabs (48). The high cost of operating a steamship and canning crabs at sea has deterred others from exploiting the fishery in this manner but increasing interest is developing in freezing the crabs for fresh markets which are expanding (48, 49).

Development of the North Pacific Albacore Fishery

The North Pacific albacore fishery is an example of one that has been stimulated by Government sponsored explorations, made in conjunction with the efforts of commercial fishermen.

Albacore was the initial species exploited by the Southern California tuna industry and has been an important item from the beginning of the industry until 1925, when this fish apparently disappeared and did not reappear in any quantity until 1938. In 1930 many schools of albacore were reported off the central Oregon Coast and individuals were taken incidentally by fishermen. In August of 1936 a sardine purse seiner caught a ton from a large school a few miles off the Oregon Coast (16, 17). During 1937 significant commercial landings were made by numerous trollers, and in 1941 an estimated 500 boats were engaged in the fishery during August. In 1948 it is probable that the size of the fleet approached 1000 boats (16, 17, 18).

In 1939 a local canning industry was started at Astoria, Oregon, following a careful study of the recorded occurrence of albacore in the past. The relationship of water temperatures and the presence of schools convinced the fishermen and packers that an annual run of albacore could reasonably be expected. With the entrance of a large fleet, in part consisting of more seaworthy seine boats and halibut vessels, the exploited area spread along the Oregon and Washington coasts and well offshore. An all time high of 34 million pounds was landed in 1944, but the catch has declined to less than 15 million pounds annually since 1945.

Canadian boats also entered this fishery in 1939, taking most of their catches off Washington and Oregon. In 1948 the Canadian Department of Fisheries started exploratory fishing operations, resulting, in 1949, in the finding of large concentrations of albacore off the Queen Charlotte Islands (16, 21, 22). Concerning this discovery, Scagel states, "It (the exploration) has provided concrete evidence concerning conditions off-shore which have in many respects been incompletely or incorrectly known. Many fishermen were skeptical of the report, as the find disagreed so completely with the preconceived notion about albacore distribution, but it took only a few venturesome vessels to draw the whole fleet to the Queen Charlotte Islands."

In 1949 explorations by the Fish and Wildlife Service, primarily directed to assess the possibilities off Alaska, found albacore from the Washington coast to a distance of 300 miles off Dixon Entrance (18). In 1950 the Fish and Wildlife Service exploratory vessel found albacore 480 miles off the coast of southern Oregon several weeks before the normal start of the commercial season, by following an analysis of anticipated surface water temperatures. Continuous explorations were made over a period of 3½ months from southern Oregon to Cape St. Elias in the Gulf of Alaska, and at distances up to 500 miles offshore, and the tuna fleet was advised by radio each day of the findings. A demarcation between favorable tuna water temperatures and the colder waters of the Gulf of Alaska was found to exist near Dixon Entrance, close to the Alaska boundary. Japanese type long lines were tried with inconclusive

results but the tests of gill nets were highly successful and over a ton was taken in a single 300 fathom set. A prime problem in the past has been to get the albacore to bite even when fish are plentiful. If net-caught albacore produce a good canned product, the results of these tests may revolutionize the fishing methods. The Service is now undertaking canning experiments to determine the quality of gill net caught albacore (23).

Oceanographic data, length and weight of fish, and stomach samples were collected by the Service exploratory fishing vessel, so that environmental factors effecting the migratory habits and commercial concentrations of the albacore could be correlated. Over 400 albacore were tagged and one was kept alive for 18 hours in a bait tank. No tag recoveries have been reported. However, three fishing vessels have reported catching tuna bearing tag marks. An uncharted sea mount was discovered which shows evidence of supporting bottom fish (23) and may be a potential albacore ground.

Here, then, is an exploratory program within a fishery and beyond its normal range, to advise the fisherman of the presence of albacore, to encourage expansion, develop more effective gear and to correlate factors in order to facilitate fishing this far ranging species. This may lead to a year round fishery such as has been developed by the Japanese through exploration.

Development of the Southern Tuna Fishery

The development of the southern tuna fishery is an outstanding example of the pioneering spirit of our fishing industry.

From the beginning of the fishery in 1911 and until 1918, the white meated albacore tuna was the mainstay of the industry. The catch was made within 50 miles of the southern California coast. Now the center of tuna production through explorations and enterprise of the fishermen, has shifted to the coast of Costa Rica, Panama, and the Galapagos Islands, and is prosecuted by the most elaborate and expensive fishing vessels in the world. Low albacore catches in 1916 and 1918 encouraged the taking and canning of bluefin, yellowfin and skipjack tunas in that order. By 1918 the increasing demand for tuna caused purse seine vessels of 46 to 60 feet in length from Puget Sound and Alaska to participate in the fishery, mainly to capture bluefin. In 1920 the industry employed an aeroplane successfully to locate fish, and several large clippers now carry aircraft to search for tuna and bait (24-28).

The period from 1918 to 1930 was one of extensive explorations and expansion of the fishery to the south. Exploration by bait boats and purse seines off lower California began in 1918. By 1923 46 per cent of the tuna delivered to American canners was caught in this area. In 1927 it increased to 77 per cent. In 1922 salmon trollers or "jig fishermen" from Monterey were quite successful in taking tuna off southern California. This began the substantial small boat fishery now extending well down the coast of Lower California. The fish were taken both inside and outside Mexican territorial waters, but the American vessels were obliged to enter Mexican ports for anchorage, supplies, bait and to sell their catch, thereby coming within the jurisdiction of Mexican authorities and causing international complications. Friendly relations had been established in 1923 with Mexican authorities, but in 1924 the fees were doubled, resulting in hardship to the industry. The fishermen's need to escape high fees and to find a more dependable year round supply of tuna resulted in a radical change in 1925, when the first long range refrigerated tuna clipper was con-

structed to carry large quantities of live bait and operate from the home port without touching Mexican ports. From 1926 and on the trend to large clippers became pronounced and a period of exploration and exploitation of more distant grounds began. In 1927 the fishery was well established to Cape San Lucas and trips were made to the Socorro Islands (about 1000 miles from San Diego and 200 miles off Mexico) and the Clarion Islands. In 1929 explorations were made along the coast of Central America and to Cocos Islands, 2400 miles south of San Pedro and to Clipperton Island, 1700 miles distant, which disclosed plentiful supplies of tuna. In 1930, the "bonanza" Morgan Bank was discovered off the coast of Mexico and the nearby Uncle Sam Bank was exploited materially for the first time. Allaire Bank was found, and several trips were made to Cocos Island and to the Galapagos Islands, 3000 miles distant from San Diego. Promising information on schools of tuna among the islands of the Mid-Pacific also developed (24-35).

From 1931 to 1950 the trend has been to explore intensely for and to exploit profitable spots in the previously discovered area from southern California to the Galapagos Islands and for distances up to 500 miles offshore. However, in 1933 an exploratory trip of 9000 miles was made to the South Seas and the Hawaiian Islands. Signs of tuna were plentiful but they would not bite and only 45 tons were taken. Other vessels have ventured to the coast of Peru but generally little fishing is done south of the Galapagos Islands. Catching adequate supplies of live bait became a problem in 1932 and power boats were introduced in 1935 to increase efficiency in capturing bait. Explorations for bait, to meet the needs of the growing fleet, were conducted in bays of Central America, and bait grounds were found in Nicaragua, Costa Rica, Panama, Columbia and Ecuador at the Galapagos Islands, where diving gear is required to free the nets from bottom obstructions. The requirements of the fishery has resulted in the development of all-purpose wells for carrying fuel, fish and live bait. Some of the larger clippers carry from 15 to 20 tons of live bait (36, 37, 42).

The introduction and development of the large tuna clipper after 1927 left the purse seiners still handicapped by Mexican taxes and restrictions, but they depended largely on the sardine and mackerel fisheries. Consequently, the need for expanding the range of this fleet was not so pressing. Furthermore, their earnings in the tuna fishery were erratic, depending on the abundance of bluefin tuna, and there was some doubt if yellowfin tuna could be successfully caught in a seine. In 1933 a mothership plan was tried off Central America with seine boats but the results were not encouraging. However, a seiner returned a catch of 80 tons from the Galapagos. Periodically the purse seiners were temporarily banned from Mexican waters or subjected to restrictions and in 1927 interest developed in adequate refrigeration to render purse seiners independent of that country. In 1947 the Pacific Exploration Company, agent for the Reconstruction Finance Corporation, operated a mothership off Central America and the purse seiners were able to capture yellowfin tuna successfully (40). In 1948 several privately owned freezer ships, almost entirely dependent on purse seine-caught fish, were operated off Central America with good results (41) and several long range seiners about 100 feet and over in length, designed to fish tuna most of the year, appeared in the fishery. These are generally fitted with a part brine and part ice system to permit thorough freezing of the early part of the catch in wells. The boats also have a large hold for icing the

remainder of the catch. These boats can also be used in the sardine fishing. (24, 31, 32, 36, 40, 41).

Development of the Overseas Japanese Tuna Fisheries

The development of the overseas Japanese tuna fisheries is the foremost example of the discovery of fisheries through government exploration and subsidy during the initial stages of development. Japan has been forced to depend on aquatic resources, not only for food for her population but for export commodities, to maintain her economic position. Consequently, the exploration and development of fisheries has been a prime concern of the government.

Soon after World War I, when the Japanese gained control of the Mandated Islands, they began to take an interest in developing fishing operations in the southwest Pacific. Between 1923 and 1925 several fishing experts found favorable prospects for commercial operations, and by 1930 various companies had established bases in the Mandated Islands, the Philipine Islands, and the Dutch East Indies, primarily to take skipjack. Operations were on a small scale, designed to catch skipjack with live bait and pole-and-line gear within 40 miles of the land bases during a single day's fishing operation. Increasing quantities placed on the home market caused prices to fall, and protests in 1937 from operators in Japan resulted in regulations limiting the oversea production of skipjack (50).

Long lining is a method developed by the Japanese for taking albacore, yellowfin, big eye and black tunas at subsurface levels. During the 1930's the tuna catch by this gear in coastal and off shore home waters approached its maximum and it became evident that increased production would require the exploitation of overseas fishing grounds. Furthermore the opening of foreign markets for tuna products in 1929 created enthusiasm for developing new fisheries (51).

The success of the Japanese long line fishery has been based largely on the ability to locate fishing grounds, since it is impossible by ordinary methods to detect the presence of far-ranging tunas when they are swimming at subsurface levels in many different parts of a vast ocean. Commercial interests were unwilling to invest the money and expend the effort to locate promising grounds in distant waters, so Japanese government fisheries organizations sponsored the exploratory phase. Their exploratory vessels compiled and disseminated a huge amount of data on the catch of fishing voyages and correlated this with various oceanographic factors such as temperatures, current drift and depth of the ocean bed. After the explorations had indicated an area to be suitable for exploitation, Japanese commercial vessels, partly subsidized by government funds, continued the development of the area. Profitable trips to the newly located grounds eventually resulted in intensive exploitation by commercial vessels (53).

During the decade prior to World War II the Japanese tuna vessels ranged throughout the entire western Pacific Ocean as far east as the Hawaiian Islands, south to the areas around New Guinea and the Dutch East Indies, and southwest into the Indian Ocean. Many of the voyages, especially those to the Indo-Pacific region and the Mandated Islands area, were explorations to determine the best fishing grounds for future development. Since albacore had the greatest export value of all the tunas fishing grounds for this species were surveyed and extended each year and eventually to the mid-Pacific area, which proved

to be an important winter fishing ground for albacore. Major fishing grounds for the yellowfin tuna and marlins were located in the tropical zone and in 1938 commercial long line fishing by large vessels based in Japan was started in the Mandated Islands area. Japanese mothership operations are now permitted in the Mandated Islands area and excellent catches are being made.

Role of Exploratory Fishing in the Gulf, Caribbean and Atlantic

The present fisheries of the Gulf were discovered and developed by the industry, but with the exception of the snapper and grouper fishery all are prosecuted within sight of shore or in relatively shallow water. Despite the tremendous development of the shrimp fishery the potentialities of the waters beyond a depth of 25 fathoms are virtually unknown except as a result of exploration now being performed by the F. W. S. *Oregon* and that done in former years during biological work of the Gulf Fishery Investigations. The *Oregon,* operated out of Pascagoula by the Service's Branch of Commercial Fisheries, is now working on Gulf problems and has found considerable quantities of presently exploited species of shrimp beyond the depths normally fished and new species in depths beyond the range of the present standard gear. Additional work may well discover new shrimp resources of great magnitude, as was the case with the development of the offshore halibut fishery.

Shrimp were found in the Gulf of Paria and off the coast of British Guiana in 1944 and are now being taken off Mexico and Panama. A survey of the fishery of resources of the Caribbean area in 1942 disclosed that shrimp are found in greater or lesser amounts mainly near lagoons, river mouths and entrances and it was concluded that shrimp fisheries can be developed in localized areas. Shrimp are known to be present off Brazil where they are taken by cast nets and haul seines in the early days of our shrimp fishery. They are also present off Argentina (54-57). The exploration and exploitation of these distant resources may not now appear feasible, but at the inception of the California tuna fishing the thought of eventually fishing at the Galapagos Islands probably appeared equally fantastic. The Amazon River system with its large delta and extensive estuary waters in many respects resembles the Mississippi and Gulf area. By analogy, the waters off Brazil may show, through exploration, promise of a shrimp fishery approaching that of the Gulf, which could be exploited by refrigerated vessels.

The menhaden fishery is confined to a narrow belt along the shore and the season rarely exceeds 5 months in any locality. Whether menhaden are confined to shore is a subject of speculation. If offshore migrations occur, explorations will disclose their existence. It may, however, be necessary to develop and test electronic equipment to locate offshore schools of menhaden and to devise special equipment to effect their capture.

Spanish mackerel, bluefish and little tuna are known to be present in the Gulf and along the south Atlantic states, and thread herring and little tuna were found off Florida in 1944. Spanish mackerel are also thought to be generally distributed throughout the Caribbean area, and while they have only been available to shore fishermen at certain seasons it may be possible to take them offshore in quantity. A fair number of schools of spotted bonita (little tuna) and Spanish mackerel have been seen off Tobago during exploratory surveys (54, 58, 59). Doubtless a thorough search of the literature would reveal many reports of these species, but exploratory work is necessary to determine how, when and where they can be caught in commercial quantities outside the already established fishing areas.

The range of the Atlantic bluefin tuna is known to extend from the Gul of Mexico to Nova Scotia, and various reports of their presence off Braz have been made. Tuna have also been noted by the *Oregon* in offshore wate of the Gulf. Long range migratory species such as tuna, swordfish and marlin occur seasonally through the Caribbean along fairly definite channels. Th Oceanic species of blackfin bonita was taken off Tobago during explorator work and such oceanic varieties as marlin and wahoo have been reported b sportsmen (42, 54, 48). General opinion has been that the clear surfac water of the Caribbean will not support any large quantities of fish becaus of low plankton content. Yet the Japanese, through the use of long line fishing at depths of 20 to 70 fathoms below the surface, have found a extensive tuna fishery in clear tropical oceanic waters. However, long lin fishing was found to be better in the Equatorial Counter current which somewhat richer in the lower forms of life than the Equatorial currents. I other areas concentrations of fish may be found which can be captured wi well-established American fishing methods. Despite the apparent absence surface signs of tuna, exploration and the development of suitable gear ma disclose a profitable fishery.

The fishing fleet of the Gulf and South Atlantic States has been rapid expanding and new resources may be necessary to maintain the prosperity the industry. These can and will be found through exploratory fishing an exploited as our markets and economic conditions require.

REFERENCES

1. THOMPSON, W. F., AND FREEMAN, N. L., *History of the Pacific Halibut Fishe* Report of the International Fisheries Commission, No. 5, pp. 12 & 20, 1930.
2. Ibid, pp. 16-20.
3. Ibid, pp. 23, 25, 27, 28 & 29.
4. Ibid, pp. 29 & 35.
5. Ibid, pp. 38, 39 & 44.
6. Ibid, pp. 44 & 45.
7. Ibid, pp. 40 & 47.
8. ANON, *Halibut* 1933, Pacific Fisherman Thirty-Second Annual Statistical Number, Ja uary 1934, Seattle.
9. ANON, *Commercial Fishery Statistics,* U. S. Department of Interior, Fish and Wildl Service, No. 516, pp. 12, 1949, Washington, D. C.
10. ANON, *Halibut Review* 1931, Pacific Fisherman 30th Annual Statistical Number, 1 19 & 181, January 1932.
11. ANON, *Halibut Review* 1932, Pacific Fisherman Annual Statistical Number, p. 1 January 1933.
12. ANON, *Halibut,* Pacific Fisherman 36th Statistical Yearbook, p. 213, January 1938.
13. ANON, *Halibut,* Pacific Fisherman 37th Statistical Yearbook, p. 221, January 1939.
14. ANON, *Halibut,* Pacific Fisherman Yearbook, p. 319, January 1943.
15. *Regulation and Investigation of the Pacific Halibut Fishery in* 1948. Report of the ternational Fisheries Commission, p. 12, 1949.
16. POWELL, D. E., AND HILDEBRAND, H. A., *Albacore Tuna Explorations in Ala and Adjacent Waters,* 1949, U. S. Department of Interior, Fish and Wildlife Servi Fishery Leaflet 376, May 1950.
17. ANON, *Tuna Production Tops All Records,* Pacific Fisherman Statistical Number, 317, January 1931.
18. *Estimate Based on Rough Information from Fisherman and Buyers.*
19. ANON, *Large Catch of Albacore from Oregon Coast,* Pacific Fisherman, 37th Statisti Yearbook, p. 138, January 1939.
20. ANON, *North Pacific Albacore,* Pacific Fisherman Yearbook, p. 187, January 1943
21. SCAGEL, R. F., *General Description of Scouting Operations and Fishing Experime* Fisheries Research Board of Canada, Pacific Biological Station, Nanaimo, B. C., Circu No. 17, p. 2, May 6, 1949.
22. PARTLO, J. M., *A Report on the* 1949 *Albacore Fishery,* Fisheries Research Board Canada, Pacific Biological Station, Circular No. 20, June 26, 1950.
23. POWELL, D. E., *John N. Cobb Completes* 1950 *North Pacific Albacore Explorati* Unpublished Preliminary Report soon to appear in U. S. Department of Interior, F and Wildlife Service, Commercial Fishery Review.

24. ANON, *Tuna Fish,* Report to the U. S. Senate in Response to Paragraph C. of Senate Resolution 159, 73rd Congress, U. S. Tarif Commission, pp. 5 to 50.
25. ANON, *California Tuna Wins Nation-wide Popularity,* Pacific Fisherman Annual Statistical Number, p. 10, January 1930.
26. ANON, *Tuna and Sardine Canning in* 1919, Pacific Fisherman Yearbook, p. 130, January 1920.
27. ANON, *Tuna Canning in* 1920, Pacific Fisherman Yearbook, p. 89, January 1921.
28. ANON, *Tuna,* Pacific Fisherman Yearbook, p. 207, January 1950.
29. ANON, *Review of the Tuna Canning Industry in* 1922, Pacific Fisherman Yearbook, p. 84, January 1923.
30. ANON, *Review of the Tuna Canning Industry in* 1924, Pacific Fisherman Yearbook, p. 100, January 1925.
31. ANON, *The California Tuna and Sardine Industry in* 1925, Pacific Fisherman Statistical Number, p. 109, January 1926.
32. ANON, *Tuna Pack in* 1926 *Lightest in Years,* Pacific Fisherman 25th Annual Statistical Number, p. 163, January 1927.
33. ANON, *Albacore Shortage Balanced by Good Pack of Other Varieties,* Pacific Fisherman Statistical Number, p. 140, January 1928.
34. ANON, *Tuna Industry Maintains Favorable Position,* Pacific Fisherman Annual Statistical Number, pp. 139 & 145, January 1930.
35. ANON, *Tuna Production Tops All Records With Pack of* 1,937,134 *Cases,* Pacific Fisherman Statistical Number, pp. 133 & 141, January 1931.
36. ANON, *Canned Tuna,* Pacific Fisherman Annual Statistical Number, pp. 117, 123 & 132, January 1933.
37. ANON, *Tuna Fishing Excellent in* 1935, Pacific Fisherman 34th Yearbook, p. 128, January 1936.
38. ANON, *Tuna,* Pacific Fisherman 36th Statistical Yearbook, pp. 137, 178 & 141, January 1938.
39. ANON, *Tuna,* Pacific Fisherman 39th Statistical Yearbook, p. 161, January 1941.
40. CARLSON, C. B., *S. S. Pacific Explorer—Part IV, Personnel and the Movement of Materials,* U. S. Department of Interior, U. S. Fish and Wildlife Service, Fishery Leaflet 326, pp. 5 & 24, November 1948.
41. ANON, *Tuna,* Pacific Fisherman Yearbook Number, 1949, p. 174, January 1950.
42. *Information Acquired Through Experiences and Interviews by Author.*
43. INVESTIGATION STAFF, *The Alaskan King Crab,* U. S. Department of the Interior, Fish and Wildlife Service, Fishery Market News, May Supplement, p. 5, 1942.
44. Ibid, p. 7.
45. Ibid, pp. 10, 11, 15 through 18.
46. ELLSON, J. G., POWELL, D. E., AND HILDEBRAND, H. A., *Exploratory Fishing Expidition to the Northern Bering Sea in June and July* 1949, U. S. Department of Interior, Fish and Wildlife Service, Fishery Leaflet 369, March 1950.
47. WIGUTOFF, N. B., AND CARLSON, C. B., *S. S. Pacific Explorer, Part V,* 1948 *Operations in the North Pacific and Bering Sea,* U. S. Department of the Interior, Fish and Wildlife Service, Fishery Leaflet 361, pp. 3 and 4, January 1950.
48. Ibid, p. 20.
49. *Unpublished data collected by the Alaska Division, Fish and Wildlife Service.*
50. SCHAPIRO, S., *The Japanese Tuna Fisheries,* Reprinted from SCAP, U. S. Department of Interior, Fish and Wildlife Service, Fishery Leaflet 297, p. 51, April 1948.
51. Ibid, p.5.
52. Ibid, p. 10.
53. SCHAPIRO, S., *Japanese Long Line Fishery for Tunas,* U. S. Department of Interior, Fish and Wildlife Service, Sep. No. 249, 18 & 20, April 1950.
54. WHITELEATHER, R. T., AND BROWN, H. H. *An Experimental Fishery Survey in Trinidad, Tobago and British Guiana,* Anglo-Caribbean Commission, pp. 21-23, 1945, Washington, D. C.
55. TRESSLER, D. K., *The Fisheries of the State of Rio de Janeiro, Brazil,* Department of Commerce, Bureau of Fisheries, .p 5, Memo S-270, March 1928.
56. CONNER, J. E., *Fishing Industry of Brazil,* U. S. Department of Interior, Fish and Wildlife Service, Fishery Leaflet 329, p. 9, September 1948.
57. ANON, *Argentine Republic,* Department of Interior, Fish and Wildlife Service, Commercial Fisheries Review, p. 33, December 1948.
58. FIEDLER, R. H., LOBELL, M. J., LUCAS, C. R., *The Fisheries and Fishery Resources of the Caribbean Area, In Cooperation with the Office of Inter-American Affairs,* U. S. Department of Interior, Fish and Wildlife Service, Fishery Leaflet 259, pp. 22 & 23, September 1947.
59. Carlson, C. B., AND FOSTER, K. P., *Experimental Purse Seine Fishing for Menhaden with the Jeff Davis,* U. S. Department of Interior, Fish and Wildlife Service, Fishery Market News, May Supplement, pp. 44, 46 & 47, 1945.

Florida's Seafood Sanitation Program

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The seafood sanitation program in the State of Florida today is limited to those products which are consumed raw, or are prepared in the plant for consumption, without any further processing by the consumer. This statement is true with the exception of scallops, and the State Board of Health would exercise no control over this product if it were thoroughly cooked before being consumed. Because of the economic factors it has been necessary for our organization to place major emphasis on that product which has in the past, or may in the future, present the greatest danger to the public's health. For this reason much of our time is spent working with people engaged in the oyster industry.

Oysters have been responsible for many cases of enteric diseases in various areas, and suspicion has fallen on those of Florida many times. It is not to be assumed from this that Florida oysters from approved sources have been incriminated in any epidemic of disease in this or any other state. There have been, however, incidents of diseases in Florida being traced to oysters taken from condemned areas. These occurred in Fort Pierce and Lyn Haven, and this year, in Vero Beach and Pensacola, where oysters from condemned areas did cause a few cases of enteric diseases. The shellfish sanitation program for the entire United States is based upon outbreaks of typhoid fever which were traced to oysters. During the period of 1924-28 the oyster industry was faced with complete shut-down. People were afraid to buy oysters and doctors looked for histories of the typhoid patients having eaten oysters. The industry was rapidly dying for lack of market. This resulted in the United States Public Health Service being asked to take over the control of sanitation pertaining to shellfish. However, the federal agency could not do this, except where interstate commerce was concerned, and the Pure Food and Drug agency was already charged with this responsibility. The solution to the problem was a cooperative program between the states and the United States Public Health Service.

The seafood sanitation program functions thus: First, the various oyster producing states each set up regulations which govern the production and handling of oysters within its boundaries. These laws are generally patterned after regulations recommended by the United States Public Health Service. The state provides for inspectional service and enforcement of its laws.

Secondly, the United States Public Health Service makes semi-annual or annual visits to the various states and evaluates the state shellfish program. They visit a representative number of oyster houses over the entire state and then approve or disapprove the entire state program, on the basis of this evaluation. If a state program is approved, any oyster house certified by the state agency appears on the certification list which is published semi-monthly by the United States Public Health Service, and sent to the various Health Departments in the United States.

Actually, the United States Public Health Service does not have any method of enforcing any regulation pertaining to the oyster industry, but any state program which is not approved, and fails to make the certification list, is in a rather unfortunate position. The remaining State Health Departments will not

permit oysters to enter their states and compete with their industry if the producer's name does not appear on the United States Public Health Service certification list.

One of the most important items in any shellfish program concerns the waters in which the shellfish are grown. The best oyster-producing areas are in waters where there is a mixture of fresh and salt water. Therefore, oysters occur where the rivers enter the sea. Early settlers chose these spots to land their ships and build their homes. Then a few moved up the river and settled other communities. As these communities grew they were faced with the problem of waste disposal, so they built sewers to collect the human waste and carry it away. Many times these sewers ran to the edge of town and emptied into lakes, ponds, sinkholes, etc. This was unsatisfactory, because of the odors, so to move the sewage farther away they decided to empty it into the river. Here it did not cause them any trouble. There were no odors and the cost of disposal was nil. This happened not only in inland towns, but also in coastal towns. The communities did not realize that they were taking filth from their communities and sending it to a point where it would settle on the oysters that would be on their tables later.

As the communities grew more pollution was added to the oyster-producing areas. Each year more cases of filth-borne diseases were traced to oysters. The various State Boards of Health were forced to close many valuable oyster-producing areas. These acts were harmful to the oyster industry, but the State Boards of Health were forced to protect the health of the people.

It has been only in recent years that we have become conscious of the tremendous amount of pollution which exists in the various bodies of water. Sanitary Engineers have sought means of disposing of this waste without polluting oyster producing areas, or causing damage to other natural resources.

The Florida State Board of Health has recently been exerting a great deal of effort to inform the people as to the problem that exists, and how the situation can be corrected. Florida citizens are now taking steps to correct their problem. In 1949 the State spent $11,504,240 to provide thirty-three sewage treatment and eight water treatment plants. This sum of money is more than all the combined expenditures of the rest of the southeastern states for this same purpose. If this effort can be continued the greatest portion of our oyster producing areas can probably be reclaimed and put back in production within the next five to ten years.

As mentioned earlier, a large number of potential oyster producing areas are now closed because of pollution, and many coastal communities are disposing of their waste into the rivers or directly into the surrounding bodies of salt water. What happens to the bacteria released into these waters? Are they destroyed by a bacteriaphage existing in sea water or by the process of sedimentation and absorption? Or are they destroyed by the effect of sunlight or some toxic substance that exists in the ocean? On the other hand, do these organisms accumulate in certain areas and continue to develop? These questions have not been satisfactorily answered. At the present time there is a study going on at Woods Hole, Massachusetts, which may help to answer these and other questions. This study is concerned with the viability of *Escherichia coli* in sea water.

This organism, *E. coli*, is one of the most widely distributed of bacteria, but it is not harmful to humans. It is one of the primary constituents of human feces, along with *Clostridium welchii* and *Streptococcus fecalis*. In the United

States the safety of drinking water, or the amount of pollution existing in body of water, is tested by determining the presence of the coliform organisms The State Board of Health is frequently asked why it does not test water fo the pathogenic organisms expected to be found in water instead of this normall harmless bacterium. The answer is that any water containing pollution of huma waste must be considered dangerous. In addition, it would be impossible t make tests for the many pathogenic bacteria which might be present. It essential to use an indicator, such as *E. coli,* for which a test can be made a matter of three or four days. Since the coliform bacteria are more harc than the pathogens, by the time they die all disease producing bacteria hav been dead for a reasonably safe period of time. Hence, it is relatively certa that no pathogenic organisms of intestinal origin exist in water which giv a negative coli test.

Some definitely established facts have resulted from the Woods Hole studi on *Escherichia coli*: (1) *Escherichia coli* population are unable to survive wh placed in raw sea water. (2) There is a marked seasonal variation in the leng of time that coli can survive in sea water: they are less viable in summer th in the winter. (3) Aging of raw sea water results in an increase in the bacte cidal activity of the water; aging of boiled and autoclaved water produces litt or no change in its bactericidal properties. (4) Sea water sterilized by boilin autoclaving, pasteurizing, and chlorinating has less bactericidal activity than ra sea water. This shows that salinity of sea water is not responsible for t bactericidal action. (5) The addition of organic matter decreases the bacte cidal activity of sea water, but it has less effect than various methods of steriliz tion. (6) It is concluded that the most probable cause of the death of *E. c* population in sea water is an antibiotic action which requires the presence of t normal marine flora.

It is not known whether these conclusions would be valid for Florid tropical conditions, but it is desirable to find out. It is possible that the jo Laboratory of the Florida State Board of Health and Oyster Division of t Florida State Board of Conservation in Apalachicola will undertake a simi project within the next few months. This laboratory in Apalachicola is one the newest developments in seafood sanitation in Florida. It was established two of the state agencies who are interested in the improvement of the shellf industry. The Oyster Division wants to produce them, and the State Boa of Health wants them safe for human consumption. With a joint laborat the best cooperation and exchange of information is possible. The Oyster Di sion has provided all essential equipment for the operation of a water labo tory, to run fifty samples per day. A portion of their building has been set as as office space for our personnel. The State Board of Health has provide twenty foot cabin cruiser which enables the collection of water samples un almost any weather conditions, and has provided personnel to operate laboratory and make inspections of the seafood houses.

The laboratory in Apalachicola has enabled the Board of Health to kee closer check on the actual conditions existing in this important shellfish grow area, and has made it possible to open and close certain areas of the Ap chicola Bay, depending on the outcome of tests for coliform organisms in water. This should result in a smaller loss of oysters to a polluted area, make it more certain that oysters produced meet sanitation requirements. P ducers are more cooperative under these conditions than under the former, flexible, system of year-long closures for certain areas.

At the request of the industry, Franklin County will provide funds to test all shellfish and crustacea shipped from the Apalachicola area. By the early part of 1951 the seafood control laboratory will be operating in a manner similar to that of the Sealtest system of quality control for milk and ice cream. Approved houses will be permitted to label their products "Produced under the supervision and laboratory control of Florida State Board of Health."

Recently in Apalachicola, in cooperation with the Franklin County Health Department, the Board of Health conducted a food handling training program for people engaged in the food industry, such as operators of restaurants, soda fountains, oyster and crab houses. The material covered in this program was concerned about equally with seafood and restaurant sanitation. Attendance at these food sanitation meetings was entirely voluntary, the only requirement was that a person had to attend one two-hour session for each of three days before he was entitled to receive the food handler's certificate, or be entitled to wear the trained food handler's emblem.

The total attendance at these classes was 256. Over half of those present were engaged in sea food work. While this may seem a small number for a community which depends entirely on seafood for its income, our program was conducted at a time when most of the crab houses were not operating and very few of the oyster houses had opened for the season.

At the suggestion of those seafood workers who attended this training program, plans are now being made to conduct another training program in Apalachicola, strictly for seafood employees. The material to be presented in this new program includes the following items: (1) Fundamentals of Bacteriology and the relation of certain bacteria to the seafood industry. (2) Construction of seafood houses and equipment. This subject will be illustrated by film strips taken in Florida. (3) Refrigeration. A surprising number of people in the seafood industry do not realize the importance of proper refrigeration for perishable food. (4) Cleaning and sterilization of utensils and equipment used in seafood houses. (5) Insect and rodent control, and their relation to disease and the seafood industry. (6) Personal Hygiene. (7) Operational techniques for seafood houses.

Of the six-hour program approximately eighty per cent of the time will be devoted to visual aids, such as posters, films, etc. The Board of Health believes that people want to be educated, and that "showing" is better than "telling." Within the next year this raining program should be available to all seafood producing areas in the state of Florida.

It has always been the policy of the State Board of Health to do everything possible to help those engaged in the seafood industry. Only as a last resort are penalties invoked for violations of sanitary regulations. Probably 95 per cent of the plant operators want help and make mistakes only because they are not properly informed. It is true that there are laws pertaining to the operation of shellfish and crustacea houses, and many of these regulations could be forced on the industry. The Board of Health would prefer to foster an atmosphere of cooperation. Otherwise the plant operator might meet the minimum physical requirements for the plant, such as a safe water supply, a concrete or impervious floor, and other similar items, but still run an unsanitary plant. Proper operational procedures might never be complied with, except while the inspection is taking place. Each plant operator and employee must understand why regulations exist if the laws are to be effective. Within a few years it is expected that 95 per cent of seafood people will be educated as to the State

Sanitary Code requirements for the seafood industry. When this day comes the Board of Health will not hesitate to use law enforcement on the remaining 5 per cent.

The services of the Bureau of Sanitary Engineers of the State Board of Health are free for the asking. The Board has engineers located in various regional offices of the State who are continually making surveys locating the source of sanitation problems. These engineers are to discuss sanitation problems with anyone concerned. The only thing the Board cannot do is supply the money which is usually required to correct sanitation deficiencies.

Chairman—ROBERT H. WILLIAMS, Assistant Director, Marine Laboratory, University of Miami, Coral Gables, Florida.

The Organization Of "Alabama Landings"

FRANCIS X. LUETH, *Senior Biologist, Alabama Marine Laboratory*
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"ALABAMA LANDINGS" is a monthly report of the landings of seafoods and some fresh water fishes, as compiled from voluntary reports made by the dealers of fish and fishery products. The figures are collected and compiled by the Alabama Marine Laboratory, a unit of the Seafoods Section of the Department of Conservation—Division of Game, Fish and Seafoods. Through a cooperative agreement, the figures are published by the U. S. Fish and Wildlife Service.

Dealers in shrimp and oysters have been required to report their landings and pay a tax on those landings since, at least, 1926. With only a few exceptions, these records have been published on a fiscal year basis in the annual reports, or the preceeding quadrennial reports of the Department of Conservation.

Dealers in fish and crabs have apparently never been required to make such reports. Some of the dealers in Mobile and Bayou la Batre report daily to the Market News Service in New Orleans. Most dealers have been contacted periodically by the U. S. Fish and Wildlife Service Statistical Section and annual production estimates have been made. However, with "Alabama Landings" the first effort has been made to get landing reports on all seafoods brought into the ports of Alabama on a monthly or seasonal basis.

Of the laws of the Alabama Department of Conservation there are two that affect the gathering of statistics for non-tax purposes. One of these laws, passed in 1939, requires that the catchers of shrimp and oysters make weekly reports. The fishermen are required to report the amount taken and the dealer to which those products are sold. The dealers are also required to make weekly reports that cover the amount bought from individual fishermen. An attempt was made to enforce this law in 1948-49. Law enforcement personnel handled the gathering and compilation of the figures. The large amount of work required was not justified by the returns and the enforcement of this law was abandoned.

A second law requires that once each quarter, on definite dates, the wholesale salt-water fish dealers report the weight of each species of fish purchased during the previous three months from commercial fishermen. This law, passed in 1943, requires the Department to furnish forms for these reports. As far as can be determined, the forms have never been furnished and the law never enforced.

The enforcement of either of the preceeding laws has not been considered in the present gathering of statistics. If laws are needed to get the proper reports from the dealers both of the laws mentioned should be repealed and a single one covering all dealers in seafoods be passed. For the present, however, figures are being collected on a purely voluntary basis.

In February of this year, a few of the larger dealers were contacted to get

their opinion of a fisheries products report. None of those visited were anxious to make a report, but could see the value of properly collected statistics and would make a report if requested. Open opposition was expressed by two relatively large dealers whose cooperation was needed if the report was to be of value. Their opposition was to making out another report. They were already reporting oyster and shrimp landings to the Department, daily seafood landings to the U.S. Market News Service, gross tonnage reports to the U.S. Engineers, freezing reports to some other government agency, and as they expressed it "just too many reports." Believing that the dealers were justified in their objections, the project was not developed at that time.

In April of this year, Mr. Bert E. Thomas, then Director of the Department of Conservation, requested the Alabama Marine Laboratory to prepare forms for a monthly products report and to undertake the collection of fisheries statistics. At the time he also requested the Game and Fish Section to do the same for the fresh-water fisheries. When the Marine Laboratory forms were ready for printing, it was discovered that the Game and Fish Section had abandoned the idea of gathering statistics. Because no licenses are required to handle fresh-water fish there was no way of locating the dealers involved. Also, with widely scattered dealers, the cost of supervision needed to get reasonably accurate reports would exceed the value of the report. Therefore, because many of the dealers, particularly in Mobile, handle both salt-water fishes and fresh-water fishes, the names of five fish commonly caught commercially in fresh water were added to the form prepared by the Marine Laboratory. It was realized that the freshwater landings would be incomplete, but a partial report was considered better than no report at all.

The forms were printed and bound into booklets. Each booklet contains twenty-four pages, alternately white and yellow. The white sheets are to be forwarded monthly to the Marine Laboratory and the yellow sheets are to be retained by the dealer as his record. The forms are as simple as possible. Each species of fish or seafood commonly landed in the state is listed. Poundage can be reported in one of two columns. One column is for the catch in "Inside Waters," that is the catch in any bay, sound or river in the State. The other column is for "Outside Waters," which refers to the Gulf of Mexico. No reference to gear is made. At present only the poundage of fish taken each month is collected.

Two blanks, one for the month the report covers and another for the date of filing, are the only other spaces to be filled in. There is no place for the firm or dealer's name. Instead, each book is numbered and a record of the book provided each firm is kept in code at the Laboratory. This was done to reduce any potential opposition to the report by those that believe it can be used to enforce the collection of taxes. All dealers have been assured that the information is confidential. Individual reports are not to be revealed to competitors or law enforcement authorities. The reports are to be published only when three or more dealers' figures can be added together. For example, the amount of oysters used for canning will not be published separately from oysters used for raw stock because only two factories do the canning.

Books were distributed in late August and early September, either by personal contact or by mail. These books went to licensed wholesale salt-water fish dealers, seafood shippers, seafood processors, live bait dealers and a few known unlicensed dealers in fresh-water fishes. Some books went to dealers who have no source of production but buy from other dealers, some licensed firms that

are now out of business, and some duplicate books went to firms doing business under two names. Corrections have been made for these. Additions are made to the list of cooperators when new firms are licensed, when it is discovered that a retail dealer has a source of production, or when a fresh-water fish dealer's name comes to light, usually at the suggestion of another dealer. After the books were distributed, the next thing was to get the reports.

The larger firms were visited first. The values to be derived from a fisheries products report were explained. The possibility of using the figures to help prevent unfair legislation has earned a number of active cooperators. In almost all cases it has taken personal contact to get the first, and sometimes the second, report. Live-bait dealers and retail fish dealers with private production sources are now being contacted.

Each firm has been met as an individual and gets individual treatment. Most dealers make the reports on the established form and in the manner intended. However, two large dealers have made arrangements to report the same figures they give the Market News Service. Some others have requested their report be taken from tax records, and where the dealer handles only oysters and shrimp, this has been done. Rather than take the time to make out the report there are dealers who would rather have the biologist compile it from a purchase book. This, too, has been done.

Of the 132 dealers who now have books, seventy-five have made voluntary reports in at least one of the last three months. The landings of a few others have been taken from the tax records. At present, those that have made no report are usually live-bait dealers or retail dealers with private sources of production. Some of the live-bait dealers, incidentally, hold their licenses merely as a means of evading the commercial shrimp laws. Of the larger wholesale fish dealers who buy from fishermen, only one has refused to submit at least one voluntary report. In his case, estimates have been made. These are based on his approximate catch in comparison to his competitors.

To facilitate the collection and compiling of the reports, cards have been prepared for each dealer. On this card is the name of the firm, address, phone number, person responsible for the report, the code number of the book provided, what licenses have been purchased, what products are produced, and notes on the response to the report. Notes on fishermen employed and the gear they use are being added to these cards.

For ease in compiling, all records are divided into eight areas of production. When sufficient reports have been collected for each area, the dealer list is checked for those that made a report. If a voluntary report was not made, the tax records are checked and a report for the dealer prepared from that source. If a report or tax record is not available for the month, an estimate of probable landings is made. This estimate is based on a knowledge of the number of fishermen employed, past records of production, and general fishing conditions. Where tax records or estimates are used, notes to that effect are made on the forms. No estimates have been made for the landings of live-bait dealers or dealers in fresh-water fishes.

After a products report has been prepared for every dealer, other than those just mentioned, they are tabulated by areas as previously stated. These tabulations are in turn compiled to make landing reports for three separate regions, namely Mobile County, Baldwin County, and the Alabama-Tombigbee River watershed. These final figures are forwarded to the Fish and Wildlife Service

in Washington for publication. The first printed report was for the month of September, 1950.

Because it is necessary to observe certain deadlines if the reports are to be issued with any regularity, estimates are made for some dealers who will eventually report. Therefore, "Alabama Landings" as first published should be considered a tentative report and subject to correction. When a report is received from a dealer after the tabulations are complete, that report is filed along with all other reports for the same month. It is planned that one year from the month of the report a corrected report will be made. This will be done by replacing the tax records and estimates by original reports from the dealer wherever this is possible.

Although the Alabama Marine Laboratory is still a one-man staffed organization, the development of this report has not been a one man job. Acknowledgements are due Bert E. Thomas for providing the stimulus in getting the report started, C. H. Lyles for personal assistance and aid in the first months of operation, A. W. Anderson, E. A. Power and others of the U. S. Fish and Wildlife Service for additional guidance and assistance, Nellie P. Landry of the Department's Seafood Office for aid in contacting the licensed dealers, Jean E. Lueth for general assistance in handling the reports as they are returned from the dealers, and the numerous dealers who have made this a truly cooperative venture.

The Organization Of The Florida Marine Fisheries Statistical System

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Fisheries biologists and economists have for many years realized the value of maintaining accurate records of fish production. Classical examples of research work in fisheries such as the Pacific Halibut investigation, the Fraser River Sockeye Salmon and the California Sardine program were all initiated by a full scale collection of the past and present statistics of the particular fishery being studied.

As has been pointed out by many workers, fisheries statistics are not easy to obtain. The difficulty of collection, together with the expense involved, has led to the neglect of this vital information in many of the fishery areas of the world. The Gulf area (with Florida in particular) is no exception.

Why must we not neglect our collection of these figures? In other words, to what use can the fisheries scientist and the economist put these catch statistics?

To the fisheries biologist they show, (1) the changes in abundance of the important commercial species by area. That is, changes in the numbers of fish caught can be noted and protective measures introduced to maintain the supply of fish for future years. In this respect it might be well to mention that many declines are of a temporary nature and an analysis of catches will indicate that the imposition of restrictive fishing measures is unnecessary. (2) Statistics permit the calculation of the availability of the fish to the fisherman, or, in other words, show the ease with which he can make his catch. This will often provide a truer picture of the stocks of fish available than does the total poundage

of fish produced. (3) An analysis of the catch by size and age composition of the fish, together with the poundage landed, allows the fisheries scientist to estimate the numbers of smaller and younger fish that will grow to a catchable size by the next fishing season.

To the economist fisheries statistics show, (1) the value of the fisheries to the state in terms of dollars and cents (2) the numbers of people wholly or partially dependant for their livelihood on the seafood resources of the state.

Florida commercial fisheries statistics have been collected by two agencies, the U. S. Fish and Wildlife Service, intermittently since 1880 and by the Florida State Board of Conservation, yearly since 1933. Poundages of fish landed by county has been collected at the end of the year, and some information has been gathered concerning the allotment of the catch and boats engaged in fishing. Both agencies readily admit that their coverage has not been adequate, due to the lack of funds or trained personnel who could devote their full time to the problem. It might be well to note that preliminary work done on the setting up of monthly reports has shown that many of the smaller wholesale fish businesses have not in the past kept the records we require. Many kept their purchase slips in a cigar box, and at the end of a year they would not make the effort required to check through all these tickets (if they were not already lost) and add up the required totals. Consequently, many of the figures obtained at the end of the year were gross estimates, and certainly open to serious question as to their accuracy. Monthly reports may not entirely eliminate this difficulty, but will unquestionably improve the accuracy of reports.

With the formation of the Atlantic States Marine Fisheries Commission and the Gulf States Marine Fisheries Commission, attention has been focused upon fisheries problems in the southern states. Papers presented by scientists of both the University of Miami Laboratory and of the U. S. Fish and Wildlife Service have urged the need for the establishment of a sound statistical system for Florida. The Florida State Board of Conservation responded by authorizing the Marine Laboratory to collect the Florida Marine Fisheries Statistics. To aid in the setting up of this system the U. S. Fish and Wildlife Service has provided the full time services of a member of their staff to work in collaboration with the staff of the Marine Laboratory at the University of Miami.

Ideally, fisheries statistics should show landings in great detail. Landings by area caught, by species, by numbers and weight of fish caught by each type of gear and reported by date of capture are all necessary for biological analysis. Realizing that there was not the scientific staff available to collect, or the clerical staff to record and compile this mass of data, it was decided to begin by collecting monthly records of poundage landed by species and area. Later the program can be expanded to include boat and gear data and other refinements. To aid in the collection of statistics the State Board of Conservation passed a regulation requiring all wholesale dealers to return a report monthly of their production by species to the statistical office at the University of Miami Marine Laboratory.

Realizing the extent of the problem, it was decided to look upon the initial phase of our program as educational. That is, the wholesale dealers must be made to realize why accurate collection of the information is of vital interest to them and also that their reports are for research purposes only, and will not be used for tax purposes. With this in mind a bulletin was prepared and sent out to all the wholesale fish dealers within the state in August, 1950. This bulletin was followed by personal interviews of all dealers in which essentially the same information was presented. From there the plan of attack was as follows: Forms

were mailed out at the end of September, 1950, requesting the poundage and the species of fish bought from the fisherman during that month. All reports are returned to the University of Miami Marine Laboratory for processing. Here they are then tabulated and the totals struck for each county. Summaries are then mailed to the U. S. Fish and Wildlife Service in Washington, D. C. for publication and subsequent distribution to the industry and other interested persons.

To keep track of all the dealers and to check delinquent reports, it was necessary to build up a card index file of all the wholesale dealers within the state. On these cards is recorded the name of the firm, names of the manager and bookkeeper, their atittude towards reporting, whether their production is fish or shellfish or both, and other general information of value to us. To match this card index, a large wall chart was prepared, which shows the complete list of wholesale dealers, listed by county, providing a check on the reports received.

The collection of fisheries statistics in Florida presents many problems rather unique to this area: (1) There are, at present, more than 700 wholesale licenses issued in the state each year. This figure is constantly in a state of flux, due to new enterprises starting up and old ones going out of business. There were over 200 such changes during 1949. (2) An interview trip to all the wholesale dealers involves driving 3500 miles. (3) Florida waters produce more than 70 marine species of fish and shell fish of commercial importance. Local names of many of the fishes are still confused, the common name of one species in southern Florida will often refer to an entirely different species in the northern section of the state. (4) Many of the dealers are in business in a small way and it is difficult to convince them of the value of accurate reports of their landings. (5) Fish are often separated and weighed by price rather than by species. For example the silver mullet and the small black mullet bring the same price to the fisherman and are consequently weighed together. Therefore reports on silver mullet landings in the past have included an unknown percentage of the other species.

There are also several other problems common to the collection of fisheries statistics everywhere: namely, (1) Many dealers fear that their reports will be used for income tax purposes or by interests anxious to restrict their fishing. In this respect all our contact with the industry has stressed the fact that landing reports are for research only. (2) Fish caught are not necessarily landed at the port nearest their place of capture and careful checks must be made in order to adjust county totals to their true values.

What has been the response to this initial effort to collect the Florida landings on a monthly basis? In general the dealers have been friendly and cooperative with only a very small fraction raising any serious objections. Almost all the resistance has been of a passive nature in that many dealers have not mailed back their completed forms by the date required. In September (the first month for which figures were requested) only 25 per cent of the dealers reported by mailing in the data as required. By personal interview another 50 per cent of the dealers submitted the required information. Altogether about 75 per cent of the reports were obtained for September, which includes an estimated 80 per cent of the fish landed, since non-reporting dealers were for the most part small operators. It is confidently expected that a considerably greater proportion of the landings will be collected as time goes on and the system is perfected.

These initial results, although not complete, are a definite step towards the establishment of a systematic collection of accurate records on our marine fisheries resources. It might be well to mention that any plan for the obtaining of fisheries statistics is constantly being revised in an effort to obtain more complete information. In this respect it is hoped that the Florida system will not be unique and that adjustment will be made to solve the many problems still remaining until in the near future accurate statistical information will be available to fisheries scientists working for the conservation and, at the same time, utilization of Florida's valuable marine fisheries resources.

The Gulf States Marine Fisheries Commission: A Progress Report

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A HISTORY OF THE EVENTS which led to the formation of the Gulf States Marine Fisheries Commission in 1949, and of its activities prior to this year is outlined in a paper presented to this Institute a year ago. The present account describes the progress made since that meeting. Encouraging advances have been made in interstate cooperation towards the solution of problems of the commercial fisheries in the Gulf of Mexico.

It was at the suggestion of the U. S. Fish & Wildlife Service, the official research agency of the Commission, that the Commission's Committee to Correlate Research and Exploratory Data met with representatives of the Service at the Gulf and Caribbean Institute in November of 1949. At the meeting further details in connection with the vessels *Oregon* & *Alaska* were made available to the Commission conferees by representatives of the Service who were in attendance. A special meeting of the Commissioners and Commission biologists and attorneys was held at New Orleans on January 6th, 1950. The purpose of this special meeting was to discuss possible initial commercial exploratory fishing endeavors to be undertaken by the *Oregon.*

Following the Houston conference by three months, the next regular meeting of the Commission was held at Tampa on January 19th and 20th, 1950. The Commission, in cooperation with the Fish and Wildlife Service, and representatives of the fishing industry, developed and adopted an initial program of Gulf exploratory commercial fishing. The program was initiated in April, following repair and conversion of the motor vessel *Oregon* and the establishing of the Service's Exploratory Fishing and Gear Development Section offices at Pascagoula. Also, at the Tampa meeting, the Commission adopted a resolution urging the Congress to appropriate sufficient funds for continuing scientific research at the Fish and Wildlife Service's Pensacola laboratory. Later these funds were provided and the Pensacola laboratory is continuing its important research activities. Realizing the importance of landing records to the proper utilization of the fisheries of the Gulf, the Commissioners adopted a resolution at the Tampa meeting petitioning the commissions of the several member states to assist and aid in the collection of statistical information and data regarding the quantity and species of fish and marine life taken from the waters of the several states, and to make such statistical information available to the Gulf States

Marine Fisheries Commission and to the U. S. Fish and Wildlife Service. With the assistance of the Service and industry, the state commissions have complied with this request and the states of Florida and Alabama, in cooperation with the Service, are now making available a monthly summary of landing records similar to that which Texas was already publishing at the time the resolution was adopted. At the Tampa meeting the Commission also approved the adoption by the Congress of the resolution S.1545, introduced by Senator McCarran on behalf of himself and thirty other Senators, for quit-claiming to the five Gulf states full title and ownership in and to all waters and tidelands within their respective borders, as well as the aquatic and marine life and the products of such waters. In this same resolution the Commission went on record as being opposed to the transfer of such title to the federal government, as contained in the Resolution S.923, introduced by Senator O'Mahoney.

Continuing with the plan of holding regular quarterly meetings during the first year of the Commission's operation, the next regular meeting was held at Biloxi, April 14th and 15th. The primary objective of this meeting was to develop a Gulf biological research program. The Commission's biologists, working with the biologists of the Fish and Wildlife Service, recommended both a long and a short range program and their recommendations, after due consideration, were approved by the Commission. Due to the extensive repairs and conversion necessary in the case of the motor vessel *Alaska*, it was learned at this meeting that it would probably be fall of 1950 before the vessel could become active in the research program. The Gulf Fisheries Investigations office has since been set up at Galveston, which port is the operating base of the *Alaska*. At the Biloxi meeting the Commission adopted a resolution designed to urge adoption of S.2801 Green, International Conference of the Northwest Atlantic, in substantially the form originally presented to the Senate Committee on Interstate and Foreign Commerce, with emphasis on that part of the Bill relating to fishery jurisdiction of the states and the preservation of the principle of state representation on the International Commission. At the Houston meeting of the Commission a Committee composed of attorneys of the conservation departments of the several states was appointed. This Committee, known as the Committee to Correlate Fisheries Laws began a study of the laws of the states. It was decided by the Commissioners at Biloxi that priority would be given at the next meeting of the Commission to the matter of developing a program of joint interstate fisheries laws, particularly those concerning the important shrimp fishery.

The next regular conference of the Commission was held at Mobile July 20th and 21st, 1950, just a few days over a year from the signing of the compact in the same city. It was the decision of the Commissioners at this meeting that insufficient background had been accumulated to draft regulations common to the five Gulf states and it was decided that a special meeting of scientists and attorneys be held in New Orleans on August 17th and 18th to prepare a suggested draft of regulations for presentation to the Commissioners at the annual meeting. Coming up for discussion at the Mobile meeting was the need for technological investigations on the Gulf. The Commission adopted a resolution setting out the urgent need for such investigations and requested that the U. S. Fish and Wildlife Service give consideration to the assigning of a full time technologist to work exclusively in the Gulf area, and on problems peculiar to this area, and that the technologist be furnished with an adequately equipped mobile laboratory. The Service recognized the need for technological work in the Gulf and has assured the Commission such investigations will be under-

taken at such time as funds and personnel are available. At this meeting the Commission also went on record in the form of a resolution to the U. S. Fish and Wildlife Service as favoring the substituting of shrimp for shark in the initial program of exploratory commercial fishing and suggested that strenuous effort be made to locate off-shore concentrations of shrimp in the waters of the Gulf contiguous to the coast lines of the five compacted states.

At the special New Orleans meeting of the Commission's Committee to Correlate Research and Exploratory Data and the Committee to Correlate Fisheries Laws, together with representatives of the Fish and Wildlife Service, a draft of proposed shrimp regulations was developed and approved for consideration at the annual meeting. Also, and in line with the establishing of joint regulations, a resolution was adopted at this Committee meeting, for possible approval by the Commission at the annual conference, recommending to the Governors and legislatures of the compacted states the enactment of laws permitting entry of the states into reciprocal agreements with one another affecting shrimp, oysters and fish.

The first annual meeting of the Commission was held at New Orleans October 19th and 20th. The principal concern of the Commissioners at the annual meeting was to study the proposed regulations in the form as recommended by the biologists and, from industry, to learn its opinion of the economic effect the application of such regulations would have upon the shrimp industry. In executive session, the Commissioners decided additional information of a purely economic nature was desirable before uniform shrimp regulations would be recommended to the several states. Ranking second in importance at the conference was the matter of reciprocal agreements among the states. It was decided that this subject should likewise receive further consideration from an economic standpoint. Both the suggested shrimp regulations and the matter of reciprocal agreements were to be the principal topics for consideration at the next meeting of the Commission, which was voted to be held at Brownsville, Texas, on January 11th and 12th, 1951.

The Atlantic States Marine Fisheries Commission: A Progress Report

WAYNE D. HEYDECKER, *Secretary-Treasurer, Atlantic States Marine Fisheries Commission, Mount Vernon, N. Y.*

I. The Treaty On The Northwestern Atlantic Fisheries

WHEN WE MET LAST YEAR, I had the privilege of reporting to you upon the International Conference relating to the fisheries of the Northwestern Atlantic, which represented a new high in federal-state cooperation. We reviewed the events leading up to the International Conference, the part played in them and in the conference by the Commission and the cordial cooperation of the Department of State. As a result of this close integration and on the assurance that the jurisdiction of the states would be protected by an adequate safeguarding clause, the Atlantic States Marine Fisheries Commission requested the Commissioners and Attorneys General of the fifteen member states, through their respective Governors, to secure the support of their United States Senators for

the speedy ratification of the International Convention. It was so ratified in record time and without a dissenting vote.

It is important to remember these facts, for our Commission could very easily have blocked consent and dragged out the matter of ratification for years, as has occurred in connection with other fishery treaties, until the implementing legislation had been agreed to in definite political commitments satisfactory to our several states. Instead we put our faith in the State Department and worked diligently and successfully to secure prompt ratification of the treaty relying upon the following language in the draft of the implementing legislation to protect state jurisdiction, Section 8 of which read, "Nothing in this Act nor in the convention shall be construed to impair the fishery jurisdiction of the several States, nor to prevent in any way the several States from giving protection to stocks of fish not covered by regulations adopted by the United States pursuant to proposals of the Commission, nor from giving additional protection to those stocks of fish covered by such regulations."

Even before the implementing legislation was introduced, certain industry groups began their attack upon it. They professed to see in the safeguarding clause, Section 8, which I have just quoted, some hidden and nefarious device for extending state jurisdiction though no such purpose was intended. When the bill came up for hearing, they renewed their attack and succeeded in getting the subcommittee and the Senate committee to strike out the safeguarding clause and in that form the bill passed the Senate. The Senate Committee in its report, however, pointed out that "none of the provisions of the bill or the convention was intended to or does in fact change in any way the status quo of distribution of federal-state jurisdiction over the fisheries."

The House Committee, after hearing the same objectors, and the states, voted to restore the safeguarding section in a modified form Section 8(d) which reads, "Nothing in this Act shall be construed to limit or add to the authority of the individual states to exercise their sovereignty within the presently defined limits of the territorial waters of the respective states." The bill with the revised Section 8(d) passed the House and was concurred in by the Senate and signed by the President.

As stated by the House Committee in its report. "The purpose of the amendment is to state clearly that neither the bill nor the convention is intended to change in any way the powers the states now have over their territorial waters. This is the intent of the words 'to limit or to add to.' "

Although the language of the section and the Committee report are not exactly as suggested by the Commission, they do make it clear that the intent of the amendment is to preserve current state jurisdiction or as the Senate report put it to preserve "the status quo of federal-state jurisdiction over the fisheries."

It is, also, significant that the same interests failed completely in their effort to block the passage and signature of HR 7887, which granted the consent of Congress to an amendment to the Atlantic States Marine Fisheries Compact permitting two or more states to act jointly through a special section of the Commission to do together what they may now lawfully do separately with respect to fisheries in which they have a common interest.

The act does not increase the jurisdiction of the states in any way, as the opponents alleged it would. The power to act jointly had been included in the Gulf States Maine Fisheries Compact, previously consented to by the Congress and HR 7887 merely gave similar permission to the states in the Atlantic States Maine Fisheries Compact.

In connection with the passage of these two measures the Atlantic States Commission received and gratefully acknowledges the fine support accorded to it by several agencies particularly by the Gulf States Commission.

In view of what transpired in this case it would seem wise for the states, in the future, to insist that implementing legislation for any treaty that affects state jurisdiction be acted upon *at the same time as the treaty* and that ratification be contingent upon the simultaneous passage of satisfactory implementing legislation.

II. Pollution Study

Special mention should be made of a Pollution Study being conducted by our Commission under a grant in aid made available to us by the U. S. Public Health Service, under Public Law 845-80th Congress. This study is limited to the economic aspects of pollution that affect the fisheries. It does not encroach on the field of the federal, state or interstate public health agencies, but is an attempt to supply economic data which should be of value to them in determining priorities for future pollution control projects. The project by special arrangement is being conducted for the Commission by the U. S. Fish and Wildlife Service, through a small staff operating from Boston.

The first phase of the work involves a summary of past pollution control efforts in each state. The second will be a more detailed study of the economic factors involved, and the third will be an appraisal of relative urgencies to be submitted to the authorities in whose jurisdiction the solutions lie.

Up to date all fifteen states have been visited. Preliminary draft reports have been submitted for review and criticism to officials of Maine, New Hampshire, Massachusetts, Rhode Island, Virginia, and North Carolina. Recommended changes have been made in three of these and are in process in the other three. Drafts for Connecticut, Maryland, South Carolina, and Florida have been forwarded for review and criticism. Drafts for New York, New Jersey, and Delaware are nearing completion and will be forwarded for criticism soon. Work is continuing on the preliminary material for Pennsylvania and Georgia.

III. Other Matters

Delaware and New Jersey are becoming interested in state catch statistics, which have been recommended by the Commission since its establishment in 1942.

After a number of meetings, it became evident that the Committee on Coordinated Fisheries Research was hopelessly divided in its opinions and in consequence, the annual meeting, last June, discharged the Committee with a special vote of thanks for its efforts in a difficult field. The different approaches to fisheries research now developing on the Gulf and Pacific Coasts, will be studied and perhaps may afford some basis for a future Committee to work upon.

Because much of the work of the Commission is done by sections, it may be advantageous to review the year's work briefly by sections.

North Atlantic Section

The North Atlantic Section has continued its interest in and study of the lobster, but shortages of both state and federal funds for research have precluded any active development of the program recommended by the Lobster Committee last year.

As an outgrowth of its study of the haddock, the Section urged and the

Commission appointed a Committee on Minimum Sizes, which in turn asked the Fish and Wildlife Service to make recommendations for various species. For haddock the Service recommended a minimum legal market size of 16½ inches measured from tip of snout to fork of tail with a tolerance of 5% by number or 2% by weight in a given catch. The Service also recommended a mesh size 4 5/8 inches stretched measure while fished, for the top of the cod end and an exemption for vessels of 50 tons or under.

For yellow tail flounder, the Service recommended a minimum size limit of 11 inches with a 5% tolerance of 5% by number. All these recommendations are under consideration by the Section and it is possible that some of them may be recommended to the several states at forthcoming legislative sections. No recommendations were made for the control of the so-called "trash fishery," because it may be serving a useful purpose by converting to fish meal quantities of hitherto unutilized and largely inedible species, which serve as competitors of valuable food fish.

The clam study conducted by the Fish and Wildlife Service, under a grant of funds sponsored by this Commission is progressing at various places along the coast, namely Boothbay Harbor, Me., Newburyport, Mass., Wickford, R. I., and Cape May, N. J. Studies sponsored by state funds are advancing in Maine, Massachusetts, and New Jersey, and interest is developing in Maryland, Virginia, and South Carolina.

Continued difficulty is being experienced by the Service in identifying causes of mass mortalities of soft-shell clams in the Newburyport area, but elsewhere the studies are moving forward on schedule. The Newburyport situation has proven baffling, but research reveals that similar mass mortalities occurred in previous years and may possibly be correlated with periods of abnormally high temperatures.

The Atlantic Salmon Research in Maine is progressing on schedule but this fish has a life cycle believed to be approximately 10 years from egg to spawning run which complicates the situation for the biologists, who must develop a scientific conservation program.

Plans are afoot for a nationwide advertising campaign with respect to the sardine, financed by the industry in Maine. In the meantime, the Co-operative Sardine Program financed by the industry, Maine's Department of Sea and Shore Fisheries and the Fish and Wildlife Service, is progressing with its biological research. The department in Maine is also tagging sea scallops and smelt.

On recommendation of a special Commission, appointed by Governor Dever of Massachusetts, there has been developed a program for freezing fish in the round at sea. This proposal was endorsed by the North Atlantic Section and by the whole Commission and funds therefore have been appropriated by the Congress. The work will center in Boston where a special unit of the Fish and Wildlife Service is being developed for that purpose.

A program of exploratory fishing for tuna in the Gulf of Maine, sponsored by the State of Maine, endorsed by the North Atlantic Section and by the Commission, has also been approved and special funds appropriated therefore. Both these programs will be underway soon.

The Striped Bass Committee, though not strictly related to the North Atlantic Section, originated there. Under the leadership of Henry Lyman, editor of the *Saltwater Sportsman* and with the cooperation of the Bingham Oceanographic Institute at Yale University, the Committee has arranged to publish a compilation of all the existing scientific material relating to this species. This compilation

the work of Dr. Edward C. Raney, of Cornell University, for which funds were made available by the Massachusetts Fish and Game Association. A striped Bass Tagging Program, sponsored by the F & M Schaefer Brewing Co. and the *Saltwater Sportsman,* is continuing and producing interesting results.

Middle Atlantic Section

The coastwise shad study, being conducted by the Fish and Wildlife Service under a Congressional grant, secured by this Commission, instituted a pilot study in the Hudson River in 1950, which will be followed by work in the Connecticut and Delaware Rivers and in Chesapeake Bay. Whether or not pollution is a factor in the decline in the Hudson River as it is believed to have been in the Delaware, is a matter to which the biologists are giving some attention.

Of particular interest both to the North Atlantic Section and to the Middle Atlantic Section is a special study to the course travelled by shad through the fish ladders in the Bonneville Dam on the Pacific Coast, the only place where shad have been known to ascend a fish ladder. From the experience gained in this study, it is hoped that suitable designs can be developed for fish ladders acceptable to shad on the Atlantic Coast. The Holyoke Power Company, now contemplating a rebuilding of one of its dams on the Connecticut River, is reported to have indicated its readiness to incorporate such a ladder in any reconstruction it may undertake. Of even greater importance, is the matter of fish ladders for shad in connection with new dams on the Delaware River, proposed by the engineers, employed by the Interstate Commission on the Delaware River Basin, for the purpose of developing a joint potable water supply for the people of that Basin.

In connection with the joint effort to bring about the restoration of the once great Delaware River shad run, the Section asked the Fish and Wildlife Service for an opinion as to the effects of the erection of dams across the Delaware River. The report made by the Service, pointing out the probable effect of each of the proposed dams has been filed with the Interstate Commission on the Delaware River Basin. That Commission has assured the Atlantic States Commission of its interest in the restoration of the shad and of its willingness to recommend any reasonable construction necessary to facilitate the return of the shad.

Studies on Delaware River shad have been deferred till next year pending the results of the pilot study in the Hudson. Meantime, New Jersey and Delaware Commissioners and fishing interests are trying to work out amendments to the Delaware River Shad Management Act which was adopted last year by Pennsylvania, but which is still to be acted on by Delaware and New Jersey.

The Commissioners of Delaware and New Jersey, at two recent meetings, have also been seeking agreement upon the regulations to be applied to the fisheries of Delaware River and Bay, lying between the two states.

Significant advance has been made in Delaware through the establishment of a new fisheries research agency at the University of Delaware, which unit is headed by Dr. L. Eugene Cronin, formerly with the Chesapeake Biological Laboratory at Solomons, Maryland. New Jersey has also increased its scientific personnel. Dr. A. Eaton Underhill has become director of the Division of Fish and Game and Dr. James R. Westman, formerly with the Department of Conservation in New York, has joined the staff of Rutgers University, which is cooperating in several research programs.

The question of the disposal of dilute sulphuric acid waste at sea off the Nev Jersey coast has caused considerable commotion in the last few years, and i our annual reports there have been presented brief summaries of the finding of the Woods Hole Oceanographic Institution and the U. S. Fish and Wildlif Service, indicating that no serious damage to the fisheries has yet been found Several reports issued by the Fish and Wildlife Service during the past yea covering the results of drift bottle experiments and observations on the effect o such sulphuric acid waste disposal have tended to confirm earlier reports.

Interest in the adoption for a uniform size limit for fluke is increasing. I appears likely that New Jersey may adopt a 14 inch limit and that New Yor in such event may revise her 15 inch limit downward to 14 inches for the sak of uniformity.

Chesapeake Bay Section

The joint crab study, undertaken by a Committee representing the Virgini Fisheries Laboratory, the Chesapeake Biological Laboratory, in Maryland, an the Fish and Wildlife Service is continuing, and important tabulations of ol and new data are being made.

A joint croaker study has been initiated by Maryland, Virginia, and Nort Carolina, which it is expected will be augmented by studies by the Fish an Wildlife Service, under recent appropriations sponsored by the Virginia Fishe ies Association and endorsed by our Commission on recommendation of i Chesapeake Section.

An illustration of the cooperation existing between Maryland and Virgini so often mistakenly believed to be in hopeless antagonism, was the operation c the fish hatchery of Fort Belvoir, Virginia by the Maryland officials and th planting of the resultant fry in Maryland waters. Both states joined to establis the Chesapeake Bay Institute, several years ago, and the Institute is now in fu swing, and in 1950 launched its new research vessel the *Maury* for hydr graphic and biological work in Chesapeake Bay. The Institute is financed joint by Maryland and Virginia, with assistance from the United States Navy's offi of Naval Research.

Although Maryand did and Virginia did not adopt the recommendations c their joint commission, to create an overall Chesapeake Bay authority for th regulation of the fisheries, the two states in the Bay are continuing to discu their joint problems in the Bay and both joined in asking their respective legi lators to introduce and work for the passage of amendment Number 1 to th Atlantic States Marine Fisheries Compact.

South Atlantic Section

At the meeting of the South Atlantic Section held in connection with th second meeting of the Gulf and Caribbean Fisheries Institute, November 1 1949, two important resolutions were adopted. The first of these called for joint federal-state cooperative program aimed to accomplish the followi objectives:

1. The development by the four states of adequate systems of comparab catch statistics, with interim provision for the collection of such cat statistics by the Fish and Wildlife Service while the state systems are bei developed.
2. Year round operation of suitable craft for the conduct of necessary biolog hydrographic, and other basic oceanographic investigations and the co

duct of exploratory fishing operations to be conducted by scientific and technical staffs provided jointly by the Fish and Wildlife Service and the scientific agencies of the cooperating states.

A similar cooperative continuing program for the compilation, and appraisal of past and current scientific data of all kinds affecting the fisheries of the South Atlantic Section and for the regular distribution of such material to the cooperating federal and state agencies and institutions and the industry.

The second resolution asked the Congress to make available funds to bring p to date fisheries statistics in the South Atlantic Section with a lesser amount hen the state systems of statistics are functioning successfully. It also re-uested the four states in the South Atlantic Section to appropriate annually ich sums as are necessary to initiate and maintain adequate permanent state ystems of catch statistics. It also asked the Fish and Wildlife Service to acquire y transfer a suitable research vessel or vessels and that the Congress appro-riate adequate funds to operate such craft on a year round basis and to pro-ide a substantial number of the scientific personnel required. At the same time ie resolution asked the four states, through their fishery agencies and labora-ories, to provide sufficient state personnel to work with federal personnel for ie achievement of the joint program. The South Carolina legislature met in egular session last year, but took no steps in this direction. Neither did Georgia, whose legislature met in an extension of its 1949 session. The forth-oming sessions of the legislatures in all four states in 1951, therefore, present he first genuine opportunity to test the willingness of the states to cooperate long the lines recommended by their Commissioners at your meeting a year go.

During 1950, the studies of the shrimp of North Carolina by the Institute of isheries Research of that state, developed new data, which have been reported o an informal group of federal and state biologists meeting here early this veek. Their conclusions were transmitted to a meeting of the South Atlantic ection held on Tuesday evening here at this conference. The Section after full discussion voted to reaffirm its previous shrimp program, but agreed to ask ts four constituent states as a first step to adopt a uniform closed season from anuary 1 to March 14 inclusive, for the outside waters from Frying Pan Shoals, N. C. south to the St. John's River, Fla. This area, including the whole oast line of South Carolina and Georgia, the northern part of Florida and the outhern part of North Carolina requires similar treatment.

In Florida, South Carolina and Georgia, the inside bays and sounds are now closed all year, although from the standpoints of biology and economics they an safely be opened 7½ months of the year when public opinion is ready to upport such a move. Until that time these waters and the adjoining North Carolina inside waters should be treated uniformly. North of Cape Fear special conditions have been found to justify the present closing of the inside waters rom January 1 to June 30.

The Section also received reports from the U. S. Fish and Wildlife Service as to the steps which have been taken to make effective the joint federal-state isheries research program in the offshore waters of the South Atlantic States, which was adopted by the Section last year.

Curtailment of non-military expenditures due to the rearmament program has necessitated some postponement of the original program, but material progress has been made in the development of better catch statistics under the joint program, particularly in Florida.

The Occurrence And Breeding Of The Chaetognatha Along The Gulf Coast Of Florida

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Abstract

From November 1948 through January 1950 plankton samples were collecte at monthly intervals from three widely separated areas along the Gulf Coast o Florida. Ft. Myers Beach, Bradenton Beach, and Cedar Key were selecte as base points and from each of these bases three collecting stations wer located about ½, 5 and 15 miles offshore.

Quantitative plankton samples were obtained with the Clarke-Bumpu sampler from each station and in addition an oblique qualitative sample wa taken with a half-meter net. Temperature records and salinity samples wer also obtained from each station. In addition to determining an overall pictur of the distribution and abundance of the chaetognaths in the coastal water it wa desired to learn what effects temperature and salinity might have on the distr bution and breeding of these animals.

The warmest water temperatures were similar at all stations (29.0-29.9°C) but the coldest water (15.9°C) by several degrees was found at the Cedar Ke station nearest the shore. The greater annual temperature range noted at th station is therefore the result of cooler water temperatures.

The salinity was lowest at the inshore stations, and increased to a maximu at the offshore stations. Fluctuations in salinity were greatest at the inshor stations and were shown to be correlated with the rainfall.

Chaetognaths from each quantitative sample were classified, enumerate and placed in one of three stages of maturity. The species of chaetognath collected were: *Sagitta hispida* Conant, 1895: *Sagitta helenae* Ritter-Zahon 1910; *Sagitta tenuis* Conant, 1896; *Sagitta enflata* Grassi, 1881; *Krohnit pacifica* (Aida), 1897.

S. hispida was found to live almost exclusively in the dilute inshore wate The only offshore station at which it was found with any frequency was Cedar Key where there was a persistent dilution of the offshore water from th neighboring rivers. It was present throughout the year at the inshore statio and often in numbers of approximately 50 per cubic meter. On one occasio in June, 1949, when many young forms were present 481 per cubic meter we recorded. This was the greatest concentration of chaetognaths found in th study.

S. helenae and *S. enflata* were normally absent at the inshore stations whe *S. hispida* was abundant. They were most numerous at the offshore statio where the salinity of the water was usually close to 35 °/₀₀. *S. helenae* was t more plentiful of the two. Both were most abundant in winter and spring.

S. tenuis appeared most frequently at the offshore stations but was occasic ally found at all stations. It was usually taken in numbers of 5 to 25 per cub meter.

Krohnitta pacifica occurred sporadically at the offshore stations and or rarely was caught close to land. The greatest concentration of this species w 28 per cubic meter taken in November, 1949. When collected at all, betwe one and five per cubic meter were the usual count.

The breeding season for all the species appeared to extend throughout t year with some fluctuations in intensity. In the case of *S. hispida* and *S. heler*

in increased period of breeding was indicated in the spring. This is in contrast to some records from northern waters where breeding appears to be more seasonal with periods when little or no breeding takes place.

There is a northward movement of water along the Gulf Coast which helps distribute the chaetognaths along the coast. This drift of water apparently does not interfere with the persistence of water of reduced salinity in the inshore areas.

A Survey Of The Present Knowledge Of The Gulf Of Mexico: A Progress Report

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Abstract

THE NEED for a comprehensive survey of our knowledge of the Gulf is great. While few oceanographic expeditions have been conducted in the Gulf, there is a wealth of information on the geology, physical oceanography, meteorology and marine biology of that body of water. This information is not readily available, but appears in periodicals, in Government reports and in various special publications. It is the goal of the proposed treatise to assemble these scattered results and to present them in summary form.

The tentative outline comprises 14 chapters, covering the history, submarine geology, meteorology, and oceanography, together with the various phyla of marine plants and animals, the biology of fishes, and the effects of pollution. The material is divided among 40 authors, each an expert in his respective field. At present the following completed articles have been received:

Trematoda of the Gulf of Mexico by H. W. Manter
Free-living Flatworms of the Gulf of Mexico by L. H. Hyman
Nemerteans of the Gulf of Mexico by W. R. Coe
Occurrence of Limulus and Phoronis in the Gulf of Mexico by J. W. Hedgpeth
Utilization of Mineral Resources of the Sea by C. M. Shigley
Bacteria and Fungi of the Gulf of Mexico by C. E. ZoBell

It is expected that the majority of the papers will be sent to the Editor within the next three monhs.

Bibliographical research conducted in the Library of Congress with the assistance of Mr. Nicholas Gregg covered primarily the early explorations of the Gulf, cartography and physical oceanography. Of considerable historical interest are the old Spanish and French records some of which give interesting data on the configuration of the coastal line and depth of water. Occasionally, these records contain references to the flora and fauna of the Gulf. The collection of bibliographical cards consists, at present, of about 500 author and 800 subject cards. Because of the absence of clerical help and the discontinuation, on August 25, of the part-time employment of Mr. Gregg, the progress in bibliographical research was slow.

Caribbean Spiny Lobster Investigations*

F. G. Walton Smith, *Director, Marine Laboratory, University of Miami; Fisheries Advisor to the Bahamas Government*

The successful control and sound exploitation of a fishery necessitates careful appraisals based upon a knowledge of the population parameters growth rates, breeding seasons, size at maturity and similar biological statistics

This desirable information is rarely available in anything like the amount o detail which the fishery biologist would like to have. Thinly scattered fisheries of the Caribbean are of insufficient monetary value to allow financial provision for any but the most cursory survey, so that our knowledge of the biological data required for optimum exploitation is even poorer here than elsewhere Nevertheless, although insignificant in comparison to the large fisheries o temperate latitudes, fisheries of the West Indies are of the greatest actual an potential importance to this protein-starved area. It is therefore fortunate tha circumstances have made it possible to obtain, with a minimum expenditure o time and money, detailed statistics of certain aspects of the Bahamas an British Honduras spiny lobster fisheries.

The operation of a canning station at West End, Grand Bahama, has pro vided an unusual opportunity of studying the Bahamas spiny lobster popula tion, since the lobsters caught at different localities were all brought to th central plant for weighing and processing. During 1945, advantage of thi opportunity was taken to visit the plant and to instruct foremen in methods o sampling and measurement. The cooperation of Mr. Hugh Griffiths of Genera Seafoods was of great value in making these arrangements possible.

General Seafoods ceased operation during 1946. Subsequently it was possibl to continue the collection of summary records only. These were made possibl by the system of government weighing stations. Most of the spiny lobster caught on the Grand Bahama banks are sold for export and the governmer requires that they be weighed or counted and recorded by an inspector befor being loaded. These records are kept by the Agriculture and Marine Produc Board in behalf of which the investigations were carried out.

The number of lobsters and the average weight of them reported at th various weighing stations are shown in Tables I and II. The value of thes statistics is evident from the summary given in Table III. From this it is clea that a decline not only in numbers, but also in average weight has occurre at the stations listed in Table III. At the same time the area served by statior at Hog Cay, Curley Cays and Bullocks Harbor show no decline in averag size. On the basis of this information it was recommended in 1950 that th Little Bahamas stations of Table III be closed to fishing.

That a drop in average size as well as in total catch indicates heavy fishin in proportion to the optimum catch was suggested in 1945. At this time comparison was made between the catch landed at West End from the heavi worked grounds and an experimental catch made at Powell's Point, then almo unfished (see Figure I). It will be noticed that the bulk of the catch landed West End was already below the legal size limit, which was not actually e forced. The conclusion is that few lobsters escaped to enter into the larg size groups. At Powell's Point, however, the trap catches of lobsters have a average cape (i.e. cephalothorax) length of at least one inch greater and t largest lobsters have a cape length of 5 inches.

*Contribution No. 55 from Marine Laboratory, University of Miami.

TABLE I

Number of Spiny Lobsters Reported in the Bahamas 1941-1950

Station	Year 1941-2	1942-3	1943-4	1944-5	1945-6	1946-7	1947-8	1948-9	1949-50
Marsh Harbor	.....	.....	13,074	5,827	.....	.....	.....	.....	.....
Green Turtle C.	.....	52,928	45,782	49,912	.....	.....	.....	52,850	26,542
Hope Town	.....	11,957	4,589	.....	.....	.....	.....	.....	.....
Carters Cay	124,969	193,736	120,397	171,947	.....	.....	.....	64,075	50,539
Red Shank Cay	357,492	345,866	208,902	151,873	.....	.....	.....	183,335	67,402
Grand Cay	22,944	78,139	131,317	152,939	.....	.....	.....	32,329	14,194
Allens Cay	119,528	153,956	123,978	97,135	.....	.....	.....	19,373	22,589
Sandy Point	.....	108,846	145,625	164,293	.....	.....	.....	53,067	36,312
Moores Island	7,315	.....	61,607	113,119	.....	.....	.....	145,585	83,976
West End	216,149	152,715	106,265	102,579	409,036	444,514	845,337	30,466	8,950
Walkers Cay	.....	.....	.....	.....	.....	.....	33,650	22,600	11,700
TOTAL	843,397	1,098,143	961,536	1,002,624	409,036	444,514	878,987	603,680	322,474
Alice Town	80,749	195,941	93,302	287,257	516,273	389,272	337,667	153,533	161,255
Bullock Harbor	.....	.....	.....	.....	.....	.....	.....	89,363	42,681
Hog Cay	38,371	76,024	126,854	180,645	.....	.....	.....	141,044	58,515
Curley Cays	.....	.....	66,920	97,432	425	.....	.....	265,645	217,609
Berry Island	17,715	.....	.....	60,406	.....	.....	.....	.....	.....
Jones Cay	.....	92,228	.....	.....	.....	.....	.....	.....	.....
Water Cay	.....	.....	.....	50,292	.....	.....	.....	.....	.....
Mangrove Cay	.....	.....	.....	2,358	.....	.....	.....	.....	.....
Nassau	141,175	124,967	1,610	.....	96,654	130,240	86,505	90,341	125,237
Palm Beach	.....	.....	.....	.....	.....	.....	.....	.....	.....
TOTAL	278,010	489,160	288,686	678,390	613,352	519,512	424,172	739,926	784,714
TOTAL ENTIRE COLONY	1,126,407	1,587,203	1,250,222	2,977,293	1,022,188	964,026	1,303,159	1,343,606	1,107,188

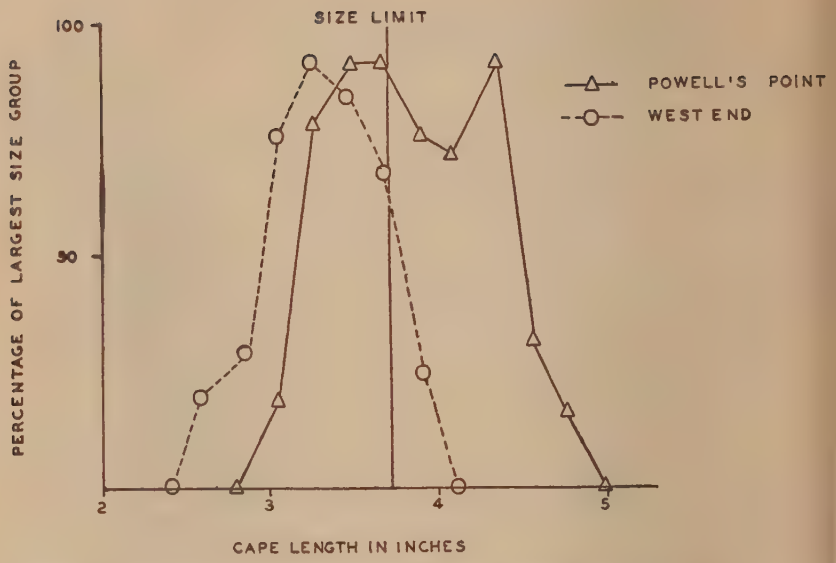


FIGURE 1. Comparison of catches at West End and Powell's Point. June 1945.

The significance of reduced catches and of reduced average size of individuals in the catch must be considered against a background of knowledge of the rate of growth and size at maturity. Fortunately the cooperation of the staff of General Seafoods at the West End canning plant made it possible to acquire much of the necessary information.

Rate of growth.

A careful study was made of the number of lobsters showing signs of moulting during each month of the year. Among monthly samples of approximately 1000 lobsters 8 per cent were moulting on an average throughout the year. While moulting occurred during every month, however, it was most evident from May to July and from December to February. Breeding females in the summer did not moult until their eggs were released. Growth of crawfish held in pens showed that the average rate of growth from the beginning of one month to the beginning of the next was one quarter inch cape length, although there was considerable variation in this.

A study of captive lobsters showed that from the time the first signs of moulting occur until the time the new shell is sufficiently hard to be indistinguishable from non-moulting individuals, an average period of 12 days elapses.

Since the yearly average of lobsters showing signs of moulting is 8 per cent it follows that the average time spent by each lobster in moulting during each year is 8 per cent of 52 weeks, or 29 days. Since the average period of moul is 12 days, it follows that, on an average, each lobster moults 29/12 or 2.5 times during the year. Thus the average total growth in cape length per yea is 2.5 x ¼ inch or somewhat more than ½ inch. It would seem unlikel therefore that a market sized spiny lobster with a cape length of 3¾ inche and a weight of 1½ lbs. is less than seven years old.

TABLE II

AVERAGE WEIGHT OF SPINY LOBSTERS REPORTED IN THE BAHAMAS 1944-1950

STATION	1944-5	1945-6	1946-7	1947-8	1948-9	1949-50
Marsh Harbor	2.32	. .	. .	. .	. .	. .
Green Turtle Cay	1.73	. .	. .	. .	2.0	1.9
Hope Town	. .	. .	. .	. .	. .	. .
Carters Cay	1.57	. .	. .	. .	1.5	1.2
Red Shank Cay	1.6	. .	. .	. .	1.5	1.4
Grand Cay	1.7	. .	. .	. .	1.5	1.9
Allens Cay	1.7	. .	. .	. .	1.7	1.8
Sandy Point	1.7	. .	. .	. .	1.5	1.3
Moores Island	1.5	. .	. .	. .	1.6	1.4
West End	1.5	1.2	1.5	1.4	1.6	1.2
Walkers Cay	. .	. .	. .	1.5	1.7	1.9
AVERAGE	1.6	1.2	1.5	1.4	1.6	1.5
Alice Town	1.8	1.9	1.7	1.9	1.8	1.8
Bullock Harbor	. .	. .	. .	. .	2.3	2.5
Hog Cay	1.9	. .	. .	. .	2.0	2.0
Curley Cays	2.6	2.8	. .	. .	2.0	2.1
Berry Island	1.8	. .	. .	. .	. .	. .
Jones Cay	. .	. .	. .	. .	. .	. .
Water Cay	2.3	. .	. .	. .	. .	. .
Mangrove Cay	2.5	. .	. .	. .	. .	. .
Nassau	. .	2.8	2.4	2.3	2.6	2.5
Palm Beach	. .	. .	. .	. .	. .	1.4
AVERAGE	2.0	2.1	1.9	2.0	2.0	2.0
AVERAGE ENTIRE COLONY	1.8	1.7	1.7	1.6	1.8	1.8

TABLE III

DECLINE IN AVERAGE WEIGHT AND ANNUAL NUMBERS AT CERTAIN STATIONS, COMPARED WITH 1945 YIELD

STATION	1950 *Average Weight lbs.*	1949-50 *catch in numbers*	*Percentage decline in average weight since* 1945	*Percentage decline in numbers since* 1945
West End	1.2	8,950	20%	90%
Carters Cay	1.2	50,539	20%	70%
Sandy Point	1.3	36,312	25%	80%
Red Shank Cay	1.4	67,402	15%	55%
Moores Island	1.4	83,976	7%	25%
Allens Cay	1.8	22,589	0	75%
Grand Cay	1.9	14,194	0	90%
TOTAL		283,962		

Breeding

Reproduction is brought about by means of a mating process in which the male lobster applies a viscous seminal fluid to the under surface of the female, between the bases of the walking legs. This hardens to form a dirty white or grey sperm packet. The eggs are laid several weeks later, at which time the sperm is released, apparently by an enzymatic action, and the eggs are fertilized.

Samples of the commercial catch or of experimental catches were examined during all months of the year. It was found that less than one per cent of females carried sperm packets in December, January and February but that at least 5 per cent bore this evidence of mating during the remainder of the year (Figure 2). Mating activity appeared to reach a peak from April to June

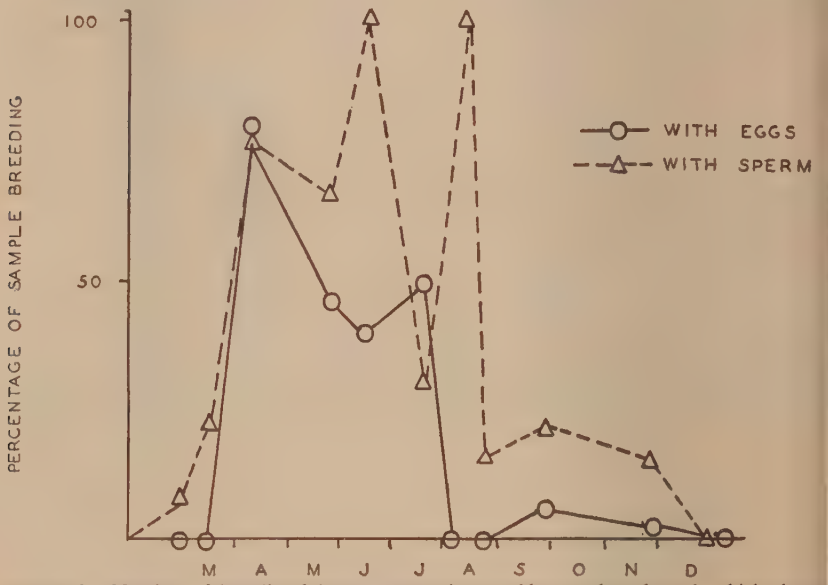


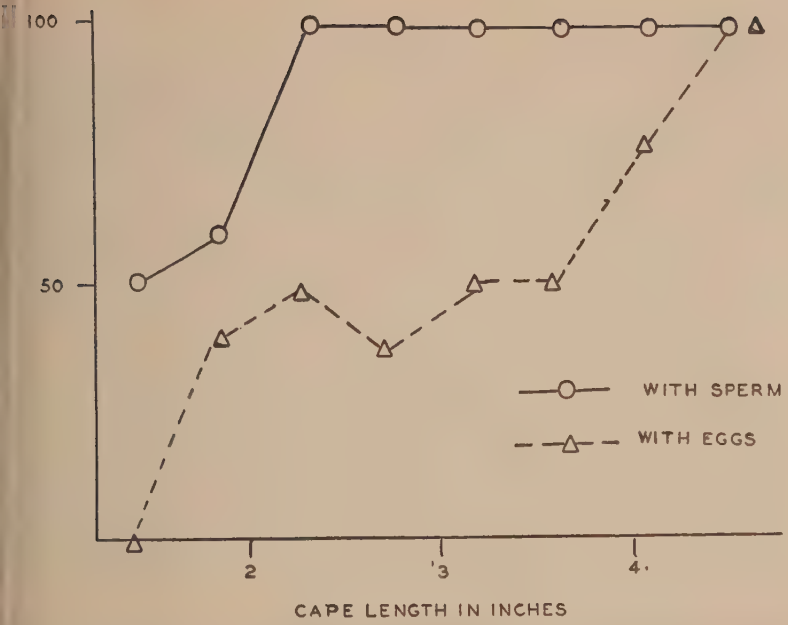
FIGURE 2. Number of breeding lobsters present in monthly samples of catch which show evidence of breeding. Monthly samples of at least 500.

and again in August. After August it rapidly declined. The onset of mating took place first of all in the larger females and occurs earlier in the southern parts of the colony.

Females begin to carry eggs during March and by the end of April the majority have attained this condition. By the end of August the majority have released their eggs, although a small number of egg-carrying females are found even as late as December.

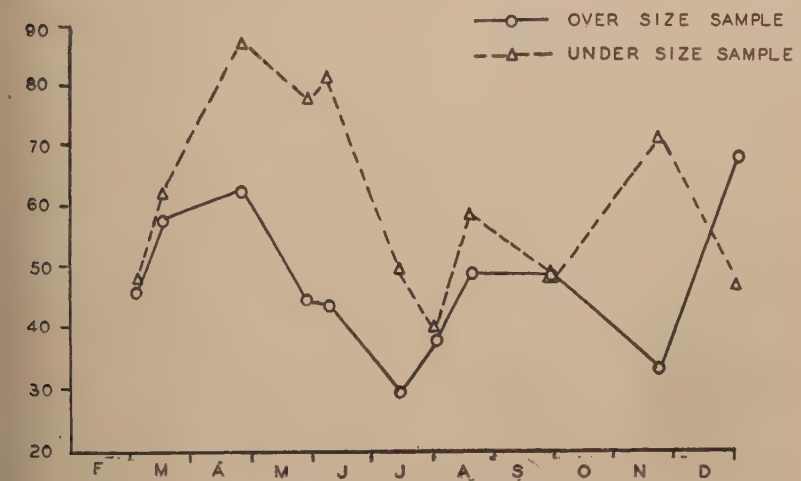
Among the several thousand examined the smallest females carrying eggs were those with a 1½ inch carapace (Figure 3). This corresponds to a body weight of less than ½ pound and a body length of about six inches. Half of the females of this size in the West End catch on June 6, 1945 showed evidence of mating.

It seems clear from the above observations that a considerable breeding potential exists in the lobsters under market size, so that the taking of undersized lobsters may not seriously affect recruitment of the younger size groups.



GURE. 3. Size of lobsters in relation to breeding activity. Sample of 800 taken at West End, June 6, 1945.

n the other hand, the heavy fishing shown by the data of Table I and Figure 1 dicates that a large loss in total catch weight is caused by not allowing dividuals to reach the larger size groups.



GURE 4. Number of females present in samples under size limit compared with number of females present in samples over size limit. Samples of 500 taken monthly at West End.

Migration

General observation shows that large troops of lobsters move en masse t various times of the year, apparently in search of food. Individuals seem move considerable distances at all times of the year. A more definite pattern migration appears to exist, however, in the summer migration of females deeper water, where most of the eggs are released. Figure 4 shows the p centage of females present in samples of lobsters above the legal limit and samples below the legal limit for each month of the year. These samples w from shallow water catches in the West End area. During May the fema begin to disappear from the larger groups. Later, in July, the smaller fema also disappear from the shallow water catch. They only appear in quan again during November and December. It is noticeable that in the wi months the females form more than 50 per cent of the catch.

From the data given above it was possible to make recommendations garding the control of the fishery. These were based upon a more accu knowledge of the condition of the lobster population than is usually the c in the fisheries of the West Indies and Bahamas. Of particular importanc this case is the comparatively negligible cost of making the study, due to fact that during the period in question the catch was almost entirely disp of to one buyer and also to the system of government weighing stations. I not unreasonable to suggest that the agents responsible for enforcement c well carry out sampling procedures in such states as Florida and obtain portant statistical information at little extra cost.

BIBLIOGRAPHY

SMITH, F. G. WALTON, 1946. *Final Report of the Bahamas Crawfish Survey.* Types Report to the Agriculture and Marine Products Board, Nassau, Bahamas.

SMITH, F. G. WALTON, 1948. *The Spiny Lobster Industry of the Caribbean and Flo* Fishery Series No. 3. The Caribbean Commission, Port-of-Spain, Trinidad.

Problems Of The Commercial Fishing Industry

Summary by A. W. ANDERSON, *Chief, Branch of Commercial Fisheries, U. S. Fish and Wildlife Service, Washington, D. C.*

IN HIS PAPER, "The Outlook for the Red Snapper Fishery," Mr. Taylor stated that the more serious problems confronting the red snapper industry were:

1. Maintenance of quality
2. Reduction of production costs
3. Stabilization of market conditions

In the paper and during the discussion it was brought out that education of fishermen and dealers was closely linked to maintaining quality. Education of fishermen by dealers and of both through short courses in schools and universities was deemed desirable. Fishery booklets on the Canadian pattern were spoken of favorably as an aid in this. Antiseptic ice appears to hold possibilities for maintaining quality but mechanical refrigeration currently appears too costly in the red snapper fishery. Freezing of the catch at sea results in a fish without the desirable red color and the frozen product consequently does not have a good market.

Production costs might be lowered by use of depth finders which are sensitive enough to indicate red snappers as small dots just above the bottom. In addition one company is making equipment which actually "sees" the bottom but the equipment is on the Navy's restricted list. Another approach is a plan whereby the company-owned vessels would eventually become the property of the captain through operation of a bonus program. The objectives would be greater production, lower costs, and improved quality.

Stabilized market conditions represent problems which must be worked out by cooperation within the producing and distributing industry.

In his paper, "Problems of Transportation and Administration in the Wholesale Fish Industry," Mr. Wegmann stressed transportation costs as the prime problem. Administration is a problem for solution within the industry itself. Transportation costs, which may mount up to as much as twice the original cost of the fish, are a more serious problem.

Suggestions offered during the discussion included research studies by universities and by government on transportation costs and means of keeping transportation agencies competitive. Container development as pursued by other food industries was offered as one solution, as was the use of dry ice. The latter was not recommended for fresh fish, however. Pooling of shipments may be feasible and profitable. Freezing the fishery products would solve many of the problems but would eliminate fresh fish as a desirable item of diet.

Mr. Meyer, in the paper "The Outlook for Breaded Shrimp and Similar Products," stated that breaded shrimp is a stabilizing factor in the shrimp market, and has not reached the saturation point. However, stronger competition is expected in the spring of 1951. Prime needs are uniform minimum standards, better packaging, improved retail handling, better transportation of small lots, and advertising. Smoked mullet, Spanish mackerel and shrimp are possibilities, but held up in part by packaging problems.

The discussion indicated that Federal standards and regulation for breadir shrimp would be preferred, as being more effective than industry regulation Air shipments are being used for breaded shrimp and parcel post would t satisfactory if delivery was prompt. Instances of excessive retail markup are deterring factor. A 10 oz. package is currently the smallest successful size.

The market for shrimp is down somewhat at present, according to M Swartz, who discussed the problem of "The Outlook for Shrimp Production At present there are relatively large cold storage inventories. Prices shou improve after the end of the Florida season in February, but should not sk rocket in view of probable steady production from other areas. Shrimp shoul however, follow upward trend of other food commodities if these prices increas

The discussion brought out that a new deveining machine handling 1,6 pounds per hour may have some effects on processing costs. It was also evide that there probably are large inventories of shrimp in private cold storage for which no good records are available.

"What does the future hold for the individual boat owner?" was t problem posed by John S. Robas. Mr. Robas stated that the individual own was faced with problems in assembling and keeping efficient crews, wi financing and credit, and with reducing production costs. He also stated th assistance was needed from the Government in the way of biological resear and exploratory fishing. The discussion indicated that individual boat owne produced fish more efficiently than company owned boats, and at a lower co Higher costs and lower returns were a problem for both vessel owner a processor. RFC loans are time-consuming to obtain. Annual crew wages in t menhaden industry are relatively low and possibly a bar to more effecti work. Sometimes it is difficult to sell catches in some areas because processo utilize catches from company-owned vessels only. State regulations in at lea one area prevent free movement along the coasts.

In "The Outlook for Continued Shrimp Production in Louisiana." M Chauvin stated that he believed the outlook was as good now as it had been the past. There was no serious damage to the nursery grounds and no eviden of overfishing.

Discussion brought out the fact that imports are beginning to be of sor concern. The price of shrimp is high to the consumer but production costs a high too. Individually owned boats are the best producers.

What Are The Most Pressing Requirements In Research In Inshore And Shell Fisheries?

Summary by W. W. Anderson, *Chief, Gulf Fisheries Investigations, U. S. Fish and Wildlife Service, and* Waldo L. Schmitt, *Head Curator, Department of Biology, U. S. National Museum, Washington, D. C*

In discussing the most pressing requirements in research in the inshore a shell fisheries, almost without exception all speakers in the Inshore and Sh Fisheries Session stressed the need for more comprehensive, long-time, co tinuous records of salinity and temperature. In more than one paper it w rather effectively demonstrated that temperature and salinity have a profou influence on the spawning and feeding of oysters, their health and well-bei

and their food supply, as well as on the distribution of shrimp. At the same time, the physiology, pathology, and, if the term may be used, "sociology" of populations as well as of individual species, should be studied as completely as possible. Species do react differently in the aggregate than as individuals. Investigations into "climatic" and physiological species and races of oysters and shrimp should be undertaken, and transplantation experiments with oysters systematically carried out. The problem of the culture of oyster spat is worth investigation. Also, information is needed on the growth rate and natural mortality of shrimp and oysters.

Perhaps the paramount requirement at the moment for advancing inshore and shell fisheries research is the standardization of methods of investigation, observation, and reporting, and of apparatus and gear used. Unless the studies and results from different areas and similar projects can be directly compared much time and effort is lost, if, indeed, the work, past or present, may not prove to be useless to other researchers.

In extension of the foregoing recommendations a broader general knowledge of plankton, both qualitive and quantitative, is needed for the Gulf and Caribbean area. What is known so far about plankton is based largely on studies made in northern waters. Planktonic forms should also be studied as individual species. Investigators of the plankton need to know more about animals and plants from the lowest (bacteria and protozoa) to the highest (phanerogams and vertebrates).

The necessity for more taxonomic work is imperative. Physiological as well as distributional studies are only as good as the systematic determinations of the organisms involved. The reliability of these determinations depends more on competent systematic workers than on existing manuals. There is a serious shortage of workers who know how to deal with the organisms in question and who know where to find and how to use the pertinent literature. Good and conveniently accessible library facilities must be provided. These, in turn, should be extensive, constantly expanded, and kept up-to-date. The progress of specific as well as general, fishery and biological problems is all too often hindered for want of sufficient basic research information and the availability of previous records. Most fish and shellfish are planktonic at some stage of life. Oceanographic and plankton observations must be made if we are to keep in touch with fluctuations of environmental factors and the number and kinds of the different stages in the life histories of species and populations.

Correlation of oceanographic and other environmental factors is highly desirable and holds great possibilities for accomplishing the solution of vital problems. For example, do temperature, plankton, or some other factor determine the migration and the "fatness" of menhaden? Further, may there not be other members of the planktonic communities besides *Gymnodinium* which could be as destructive in times of great abundance as the Red Tide of the west coast of Florida?

Comprehensive programs of the sort here advocated have been too long delayed. There is altogether too little background or past information available, and the sooner this dearth of information is overcome the more certain and productive will be the results of future work. To achieve the objectives of those programs, this Institute must strive to bring about closer cooperation and better exchange of ideas between individuals and agencies carrying on research on the inshore and shell fisheries.

To accomplish this there should be established some practical machinery for assembling, correlating and reproducing existing and future data. This is now widely scattered in the publications of highway, bridge, harbor, and other construction engineers, Federal, state, river-basin and defense agencies, fishery and biological establishments, industrial plants, and oil companies.

Attention may here be called to the serious effects that the improvement of harbors and ship channels has on the life of the waters concerned. Dredging, fills, and the construction of sea walls inevitably bring about changes in character of bottom, the direction and force of currents, the elimination or destruction of beaches, marshlands, and mangrove swamps. Many species are deprived of food and shelter, breeding grounds, and nurseries. Such radical changes in environment create a real need for ecological investigation in order to learn what to do about "improvements" on the one hand, and the preservation of natural conditions, upon which depend the continued existence of useful and commercially valuable species, on the other.

It was further suggested that some means for the prompt dissemination of information regarding work being done in the inshore and shell fisheries field be instituted. Progress reports, if only in the form of a mimeographed newsletter, are of inestimable value in keeping all interested parties posted as to developments throughout the area. The responsibilities of the Institute members should include the providing of material for at least a quarterly report to be issued by some agency to be selected or established.

The Institute should consider arousing a wider interest among college students, the teaching profession, and the lay public than at present prevails. In this connection it is recommended that all institutions conducting fisheries schools or giving courses of study in marine biology or oceanography require for full credit in such courses that some time be devoted to the acquiring of actual operational experience on some fishing vessel or with some seafood processing plant. A course of practical navigation should also be required, or in its place, a demonstration of ability to navigate a reasonably sized craft. Equally essential are practical English composition, report writing and competency in public speaking.

The existing biological and marine laboratories and state agencies within their present means and facilities, are doing commendable work. However, if they are to advance their programs there are several urgent material needs that must be met:

First, suitable vessels with proper equipment. The continuous work of the *Pelican* in the Gulf of Mexico discovered the wintering grounds of shrimp and the potentialities of the Gulf shrimp fishery that led to their further exploitation and present great development. Vessels are of prime importance to all marine research. Together with reasonable additional facilities, they would make possible highly desirable, concerted, simultaneous observations that could be directly compared.

Second, adequate and competent personnel for these vessels.

Third, additional or improved laboratory and library facilities, and

Fourth, substantial financial support for the broader programs outlined in this summary of the most pressing requirements in research in inshore and shell fisheries.

What Are The Most Significant Economic Trends In The Gulf And Caribbean Fisheries?

Summary by Richard A. Kahn, *Chief, Economics Section, U. S. Fish & Wildlife Service, Washington, D. C.*

On the basis of the papers presented during the Economic Session and on the subsequent discussions, the following economic trends in the Gulf and Caribbean fisheries can be observed:

1. There is a tremendous amount of fishery waste material (more than 300 million pounds per year) available in this area, which at present is used for commercial purposes only to a small extent. However, the main problem lies in improving the commercial use by proper collecting and reducing methods. Some areas have advantages in this respect over others. Shore landing facilities, processing plant and packaging houses are concentrated as in Florida, Louisiana and some other areas. Successful operation of waste reduction has begun in some places. In other areas the problem of transportation with regard to waste material is being attacked, and it can be expected that the industry will continue to use more and more waste material economically instead of throwing it away. Fishing for trash fish has become an activity in itself in some parts of the Gulf and Caribbean area. The present price of ½ cent per pound of trash fish, paid to the fisherman, gives supplemental income to boat owners and crews and permits the profitable operation of reduction plants even on part-time basis. Fishing for trash fish in some parts of the area is under legislative control and the trend is in the direction of licensing such control or at least bringing such control in accordance with the results of biological research and the demands of sound fishery management.

2. Observations of the Brownsville shrimp fishery led to the discussion of the shrimp situation in the area of the Gulf of Mexico and of the Caribbean Sea. There was unanimity of opinion that the shrimp resources are still great and to a large extent undiscovered. However, the trend is in the direction of adjustment of production and processing to price and market conditions. Fishermen will reduce operations if prices fall below a certain level, and imports from countries as Mexico and Honduras will decrease if the lower market price in the United States does not justify the higher transportation costs involved in such imports.

3. The paper on charterboat fishing in the Miami area revealed important new data on charterboat investment and income of boatowners and crew members of charterboats. There is a trend to extend charterboat fishing, and also partyboat fishing, from the mere sporting pleasure to implementation of the food supply, either of participant non-fishermen or of the crew members, who receive parts of the catch and sell them. It was the desire of the audience that these studies on the economic importance of charterboat and partyboat fishing be continued and perhaps enlarged as to include studies on the economic importance of sport fishing generally.

4. The Representative of the Netherlands gave an encouraging report on the fisheries in Surinam. There are great resources still untouched in the Guianas and the trend is to discover them by governmental exploratory fishing and to use them for implementation of the diet of the natives.

5. The paper on sponges revealed the strong competition the natural sponge faces by the synthetic sponge. However, opinion polls conducted among

druggists and hardware retailers in the United States reveal that consumers would in many cases prefer natural sponges if only the price would be in proper relationship to the price of the synthetic sponge. A price reduction of about 25 per cent could increase sales by about 300 per cent. In addition proper grading, good packaging, advertising, and availability in all desired sizes and at all times and conditions, upon which the expansion of the natural sponge market depends.

Reports from the Bahamas indicate that there is a trend towards recovery of the sponge beds which were depleted by diseases and overfishing about ten years ago. The encouraging report from the Bahamas justifies the hope that the Tarpon Springs area in the near future also will regain its former importance as the sponge production center of the United States.

In the discussion it was observed that, due to generally improved economic conditions in the Gulf and Caribbean area, the diet of the natives is improving, that fresh and frozen fish are entering markets in Puerto Rico, Venezuela and in other countries of this area, where formerly the inexpensive salted cod was the main fish food the native could afford. However, there was regret expressed that transportation conditions in many parts of the Caribbean area are still in a lamentable state so as to prevent the full use of the local fishery resources in the interest of the native population and in the economic interest of the area as a whole.

Many areas, however, report increased industrial fishery activity, as, for example, Haiti, the Dominican Republic, Panama, Cuba, Mexico and, last but not least, the Gulf States of the United States. It can be hoped that this increased industrial fishery activity continues to contribute to the rising economic welfare of the people of our area.

How Can The Present Research In Exploratory Fishing And Fishing Technology Be Most Profitably Expanded?

Summary by R. T. WHITELEATHER, *Assistant Chief, Branch of Commercial Fisheries, U. S. Fish and Wildlife Service, Washington, D. C.*

During the discussion following "The *Oregon's* Investigations and Future Plans for Research" by Stewart Springer, the speaker further elaborated on the results of the deep water shrimp trawling investigations of the *Oregon* indicating the practicability of trawling in depths of 250 fathoms with proper winches and other equipment. The *Oregon* haul-backs of the trawl took about 28 minutes when fishing at 250 fathoms. Although only a few drags were made, there was some indication that *Hymenopenaeus robustis* may exist in commercial quantities off Mississippi. Those caught had a pleasing taste, more like lobster and crab than common shrimp, but were soft in texture which may affect keeping quality. This species appeared to hold up satisfactorily when frozen aboard the vessel, however.

Questions arose as to scrap fish and invertebrates taken incidental to the general shrimp trawling work in the Gulf and as to utilization of those species. Great beds of echinoderms exist in some areas, but whether these have food or industrial value is questionable. Scrap fish, particularly small croakers, were taken in commercial volume but utilization is a difficult problem from the economic standpoint, owing to the lack of oil yield.

Further investigations will incorporate a number of suggestions offered during the discussion; namely, use of tickler chain on trawl to increase catch; experiments with mid-water trawling gear; testing methods to improve red snapper catches and trying chum and dip nets for Spanish mackerel.

Mr. J. L. Baughman's paper, "The Menhaden Fishery of Texas," led to a reiteration that much of the misconceived information on the harmful effects of menhaden fishing operations on other fisheries stems from unfamiliarity with the menhaden fishery. Educational programs to acquaint those misinformed on the industry and its activities was recommended. Mr. Baughman pointed out that less than 3 per cent of the food of various fishes examined in his studies consisted of menhaden, and that the percentage is so small that menhaden are insignificant as a food factor for other fish. The studies included the fishery in Louisiana as well as in Texas and the results would be equally applicable to the Louisiana fisheries. It was also emphasized that the menhaden population must be extremely large, since there is no evidence of depletion at the present time. Some comments were made on the destructive effect that seining in shallow water may have on the habitat for bottom fish. It was indicated that in some cases stirring up the bottom might improve fishing, especially on soft bottom. Opinions concerning this question varied somewhat and suggestions were offered that future investigations be broadened to include habitat studies along with food studies to acquire complete knowledge in this field.

"The Use of Echo Sounders in the Fisheries," by Ewing Lawrence activated interested discussion of possibilities of developing horizontal electronic fish scanners since the ordinary depth recorders are limited to vertical ranges. Several difficulties are involved in horizontal scanning, one of which is the stratification of the water resulting in sonic energy being bent or refracted by the interfaces. There was some variation in opinions of the seriousness of this difficulty, however. Further complications in the development of satisfactory scanning instruments for fishing vessel use is the necessarily complex nature of the equipment. Customarily, fishing vessels are not manned or equipped to cope with maintenance of such complicated equipment in order to keep it operating effectively. Some attempts have been made to adapt military underwater scanning equipment to fishing vessel operations, but this does not seem practical.

On the regular depth recording instruments commonly in use at present, certain species of fish can be detected satisfactorily, especially those fish that school. There are some instances which indicate that shrimp have been shown on the recorder off the west coast of Mexico on soft mud bottom. The recorder marks appeared as dark patches on the bottom line recording. Where erratic soundings are noted, it is not probable that the vessel will be running over a school of fish so dense that no bottom soundings show. In the Gulf area certain patches of green mud give off gas in bubbles which obscure bottom soundings by showing as a line or in other cases eliminating the echo entirely. In spite of such variations from normal operations, depth recorders are well recognized as being advantageous in commercial fishing operations.

The general discussion on "Control of Fish Spoilage by Icing and Freezing" following the paper by Harold E. Crowther, brought out that the rate of freezing fish is an important factor, but low storage temperatures are even more so in maintenance of quality. Even if the freezing rate is slow and large crystals are formed in the cells of the fish flesh, recent experiments show that low tempera-

ture storage will maintain quality. Opinions varied nevertheless as to effect of slow freezing on the amount of "drip" upon defrosting the product. The amount of drip is generally proportionate to the length of storage period. Present Fish and Wildlife Service studies in the freezing-fish-at-sea project with the vessel *Delaware* in the New England area may help resolve this question.

The question arose as to the value of adding salt-type material to ice to lower the temperature when holding fish in wet ice refrigeration. It was pointed out that this may be advisable to a certain point. However, various species differ in freezing point; for example, cod soften at 28° F., and there is no way of lowering the temperature below that point for non-frozen refrigeration.

Experiments indicate that fish flesh itself is sterile but mucous (slime) and the intestinal tract are not. Bacterial contamination comes from these sources and consequently is a factor to consider in freezing and preserving high quality products.

"The Role of Exploratory Fishing in the Development of the Commercial Fisheries," was discussed by Carl Carlson, and the subsequent comments pointed up the fact that commercial fishing will always expand into new areas once the economic feasibility for such a move is established. There was considerable interest in the possibilities of commercial quantities of shrimp in the waters off the east coast of South America and whether large vessels constructed for long-range operation homing in Gulf ports could fish those areas. There are very limited data on resources off the coast of South America, but if higher production is reasonably obtainable such long-range fishing conceivably could be undertaken. It would require some changes in equipment and especially installation of freezing apparatus on vessel.

In answer to a question about possible transfer of a portion of the tuna industry to the Gulf Coast, it was brought out that such ventures are under consideration by some companies now, since Gulf ports are about 1000 miles closer to the Galapagos Island fishing area. Several problems are attendant in a shift to the Gulf—primarily the need for proper bait. Also, special inducements are necessary to persuade crews and others to shift locations. Shifting purse seiners would not involve bait problems that are entailed in the moving of clipper vessels. There is not much information on bait resources in the Gulf area. However, there is some possibility that small menhaden may be the solution to the bait problem. Experiments have indicated that these fish can be kept alive in bait tanks for long periods. More research is needed before any positive conclusions can be reached.

After some general statements on fishery sanitation problems in Florida and other states, following the paper by Richard P. Hardison entitled "Sanitation in the Seafood Industry," there was an inquiry as to the possibility of purifying oysters from polluted areas. Although oysters can be cleansed by proper processes, the excessive cost has prohibited use of purification plants in reclaiming this portion of shellfish resources. The Health Department is cognizant of the need for improvement in sanitation in various segments of the industry and of some inequities that allow "fly-by-night" operators with poor facilities to compete with progressive producers and processors. State legislative action will be attempted to correct some of these situations.

Appendix I

A Bibliography On The Fishes And Fisheries Of Puerto Rico

PEDRO JAIME SOLER
College of Agricultural & Mechanical Arts, Mayaguez, P. R.

THE INFORMATION contained in this bibliography is the result of the author's research in the files and the libraries of the Department of Agriculture and Commerce of Puerto Rico, the Fishery Research Laboratory of the United States Fish and Wildlife Service at Mayaguez, Puerto Rico, the Insular and Federal Experimental Stations, and the libraries of the University of Puerto Rico at Río Piedras, and at the College of Agriculture and Mechanical Arts at Mayaguez, Puerto Rico. It is the continuation of study begun at the Graduate School of the University of Miami.

The listing is as complete as the time alloted for it permitted. Most of the material is widely dispersed and difficult to find. It is the intention of the compiler to continue investigations and subsequently to publish a revised list.

Looking forward toward a more complete and more useful contribution, an annotated bibliography has been begun, and an attempt is being made to assemble at least one copy of every book, article, bulletin, and unpublished paper available on the subject of "Fishes and Fisheries of Puerto Rico."

The literature thus brought together will provide for the student and the general public information as regards experiments, studies, plans executed and underway in Puerto Rico for the promotion of the fishing industry and the problems confronting the industry. The cooperation of our libraries, our government agencies, authors, sportsmen, and others in obtaining further references is solicited.

The author acknowledges the encouragement and assistance received from editors, librarians, and authors especially Mr. Miguel Meléndez Ortix and Mr. Felix Iñigo, of the Department of Agriculture and Commerce of Puerto Rico, who offered the facilities of their files and libraries. Recognition goes also to the University of Puerto Rico and to the officers who made this work possible.

Corrections, suggestions, and additions will be appreciated for this and the future work now in hand.

THE AMERICAN FISHERIES SOCIETY FAVORS LEGISLATION FOR PUERTO RICO.
1940. *A Resolution.*
Revista de Agricultura, Industria y Comercio Vol. XXXII Núm. 4.

ANGLO AMERICAN CARIBBEAN COMMISSION
1945. *Guide to commercial shark fishing in the Caribbean Area.*
A publication of the Central Secretariat of the Commission, Kent House, Port of Spain, Trinidad.
1948. *The fish trade of the Caribbean.*
External trade Bull. No. 3 of the Central Secretariat of the Commission, Kent House, Port of Spain, Trinidad, pp. 53-55.

APRUEBAN CENTRO DE PESCA PARA FAJARDO.
1944. Noticias del Trabajo, vol. II, Núm. 45, p. 7.

ARRECHE, CANDIDO C.
1940. *Una entrevista con el Sr. Luis C. Bonnet. Jefe de la división de Ornitología y Piscicultura del Departmento de Agricultura y Comercio de P. R.*
Impresiones sobre su viaje de estudio e investigación por Estados Unidos y Canadá.
$25,000 *para la construcción de un laboratorio de Productos Pesqueros.*
Otros detalles interesantes que debe conocer nuestro pueblo.
Revista de Agricultura, Industria y Comercio Vol. XXXII, Núm 4, pp. 473-475.

Asenjo, Conrado F.
1940. *Brief Notes on the Chemistry of Shark Liver Oil with special reference to its vitamin content.*
Revista de Agricultura, Industria y Comercio de Puerto Rico, Vol. 34, núm. 2, pp. 205-207.

Bague, Jaime.
1929. *Orientaciones agro-pecuarias de actualidad.*
Revista de Agricultura, Industria y Comercio, Vol. 24, p. 250.

Barlett Howell Sturcke
1943. *A Development plan for Puerto Rico.*
A publication of the Planification Board for Puerto Rico.

Barnes, Ventura Jr.
1943 a. *Aspecto biológico de la pesca en Puerto Rico.*
(Unpublished paper, kept at the Fishery Laboratory Library at Mayaguez, Puerto Rico).
1943 b. *Survey of fishing grounds in the vicinity of Puerto Rico.*
1. Banks fished (Pelagic and bottom fish).
2. Season of the year that banks are fished.
3. Kinds of fish caught.
4. Types of gear used.
(Unpublished paper, kept at the Fishery Laboratory Library at Mayaguez, Puerto Rico).

Barret, O. W.
1927. *Los métodos modernos en la pesca del tiburón.*
Revista de Agricultura de Puerto Rico, Vol. 19, núm. 2: 65.

Bello y Espinosa, Domingo.
1871. *Zoologische Notizen aus Puerto Rico.*
Nach dem Spanischem frei bearbeitet von Herrn E. von Martens in Berlin.
Zool. Garten, Vol. XII, pp. 348-351.

Bonnet, Luis C.
1937. *The Fishing Industry of Puerto Rico.*
A thesis presented to the faculty of graduate school of Cornell University.
1940. *Wildlife Conservation in Puerto Rico.*
Revista de Agricultura y Comercio. Vol. 32, p. 152.
1940. *Possibilities for the Promotion of the Commercial Fisheries of Puerto Rico.*
Transactions of the American Fisheries Society.
1941. *Desarrollo y Planes para la pesca de agua dulce en Puerto Rico.*
Revista de Agricultura, Industria y Comercio, Vol. 33, año 20, núm. 3, pp. 339-346.
1942. *Puerto Rico embarks on extensive fishery program.*
Revista de Agricultura, Industria y Comercio de Puerto Rico. Vol. 34, núm 1, pp. 100-101.
1943. *An address at the "Lions Club" of Mayaguez.*
Fishery Bull. of Puerto Rico. Vol I, núm 1.

Buitrago, Zaida.
1949. "El suelo, los recursos oceánicos, la industria pesquera." *Colección América.*
Tomo 10. "Puerto Rico" pp. 25-27.

Colombani, J. C.
1923. *El porvenir de los aceites de pescado.*
Boletin de Comercio, Puerto Rico. Vol. XI, p. 35.

Combas Guerra, Eliseo
1935. *"Pescado Fresco de Puerto Rico. Una visita a la Pesquería de la PRRA en Boca Cangrejos."*
Puerto Rico Ilustrado 1935, año 26 núm. 1334, p. 36.

Commercial fisheries to be developed in Caribbean area:
1942. Foreign Commerce Weekly. Washington, vol. 7, p. 21 (May).

Cope, Edward Drinker
1871. *Contribution to the ichthyology of the Lesser Antilles.*
Trans. Amer. Phil. Soc. Vol. XIV, pp. 445-483.

Danger of War Time Shortage Intensifies Commercial Fisheries Research.
Fresh water fish are now available in Island Rivers.
1940. Revista de Agricultura, Industria y Comercio de Puerto Rico. Vol. 35, núm. 2, pp. 317-318.

Davila Rivera, Emilio A.
1944. *Breve Estudio de las Condiciones Sociales y Económicas de los Pescadores del centro pesquero de Ponce.* Revista de Agricultura, Industria y Comercio de Puerto Rico. Vol. 35, núm. 2, pp. 200-204.

Del Valle, Atiles Pedro.
1930. *Pasatiempos de Antaño. La Pesca del Tiburón.*
Almanaque Asenjo, pp. 53-54.

Descartes, S. L., Diaz Pacheco S.
1938. *El consumo de alimentos en la ciudad de San Juan.*
Circular No. 107. University of Puerto Rico, College of Agriculture and Mechanical Arts. Insular Experimental Station.

Descartes S. L., Diaz Pacheco S. and Noguera, J. R.
1941. *Food Consumption Studies in Puerto Rico.*
Bull. No. 59, Agricultural Experimental Station, Río Piedras, Puerto Rico (January)
Detalle de la distribucion de peces efectuada con alevines producidos en el vivero de peces de Maricao.
Departamento de Agricultura y Comercio, División de Pesquería y vida silvestre.
Diaz Pacheco, S.
Consumo de Alimentos en la zona urbana de Puerto Rico.
Bull. No. 52, Agricultural and Experimental Station, Río Piedras, Puerto Rico.
Diaz Pacheco, S. Velez, M. and Vazquez Calcerrada, P. B.
1943. *Practice and Operating Costs of Puerto Rican Fishermen.*
30 pages mimeographed, Report No. 21. Agricultural Experimental Station, University of Puerto Rico.
Division de Industria Pecuaria del Departamento de Agricultura y Comercio.
1942. Boletín Mensual del Departamento de Agricultura y Comercio, vol. I, núm. 5, p. 5-6.
Erdman, Donald S.
1945. *Apuntes sobre algunos peces del nordeste de Puerto Rico.*
Revista de Agricultura de Puerto Rico, vol. XXXVI, núm. 2, p. 167.
1947. *Aquarium Fishes in Puerto Rico.*
Revista de Agricultura, Industria y Comercio, vol. XXXVIII, núm 1, pp. 90-91 (Jan.)
1949. *Does the Spanish mackerel occur throughout the West Indies?*
Copeia núm. 4, p. 301 (Dec. 15)
Evermann, B. W., and March, M. C.
1899. *Description of new genera and species of fishes from Puerto Rico.*
U. S. Commissioner of Fish and Fisheries. Commissioner's Report for 1899. Doc. No. 427, Gov. Prtg. Off., Wash., D. C. p. 351-362.
1902. *Puerto Rico, Its Fishes and Fisheries.*
Current Encyclopedia, 1902, vol. 2, 1274-1279.
Fiedler, R. H.
1939. *Fishery Educational Work and Review of Interior and Marine Fisheries in Puerto Rico.*
A travel report by the author as technical adviser on fishery matters to the President's Educational Commission to Puerto Rico on the request of Dr. Ernest Gruening, Director of the Division of Territories and Insular Possessions, Department of Interior. Unpublished paper kept at the Fishery Laboratory Library at Mayaguez, Puerto Rico.
Fiedler, R. H. Lobell Milton J. and Lucas Clarence R.
1943. *The Fisheries and Fishery Resources of the Caribbean Area with recommendation for their expansion and development.*
A report of the Caribbean Fishery Mission. U. S. Department of the Interior. Fish Wildlife Service, Fishery Leaflet 259.
Fish for defense.
1942. Business Week. (March 21) p. 42.
Fishery Resources of Puerto Rico. Character of the coast and ecological condition.
Unpublished paper at the College of Agric. & Mech. Arts, Mayaguez, Puerto Rico.
Fishery Survey in Puerto Rico.
1934. Science news (April 20) No. 79: 356-7.
Fishery at home.
1943. Business Week (May 1) p. 58.
Fomento de la Pesca.
1944. Noticias del Trabajo, vol. II, núm. 46, p. 8.
Fresh Water Fishing Trip.
1950. Qué Pasa en Puerto Rico, Vol. 2, No. 17, August 1, 1950, San Juan, Puerto Rico.
Gandia Cordova, Ramon.
1930. *Organización del Servicio de Pesca.*
Revista de Obras Públicas, vol. VII, núm. 7, p. 203-205.
Gilman, Robert L.
A Review of Fish Poisoning in the Puerto Rico-Virgin Island Area. A Report of ten cases occurring in Culebra Island.
(Unpublished paper kept at the Dept. of Agric. and Comm. Library).
Hibben Thomas, and Pico Rafael
1948. *Industrial development of Puerto Rico and the Virgin Islands of the United States.*
Report of the U. S. Section, Caribbean Commission.
Hildebrand, Samuel F.
1934. *An Investigation of the fishes and fish cultural possibilities of the fresh water of Puerto Rico, with recommendations.*
An unpublished report to the Commissioner of Agric. & Comm. of Puerto Rico. Unpublisher paper kept in the Fishery Laboratory Library at Mayaguez.
1935. *An annotated list of the fishes of the fresh waters of Puerto Rico.*
Copeia, núm. 2.
Hill, E. B. and Noguera, J. R.
1940. *The food supply of Puerto Rico.*
Bull. 55 Agricultural Experimental Station, Río Piedras, Puerto Rico.

Industria Pesquera:
1944. Noticias del Trabajo, vol. II, núm. 53, p. 4.

Informe de las Actividades desplegadas por la Division de Ornitologia
1941. y Piscicultura Durante los meses Comprendidos entre Julio y Diciembre 1941.
Revista de Agricultura y Comercio, vol. XXXIIII, año XX, p. 516-518.

Informe del Comisionado de Agricultura y Comercio Division de Pesqueria y Vida Silvestre.
1943-44. pp. 109-115.
1944-45. pp. 22, 119-122.
1945-46. pp. 20, 22, 113-115.
1946-47. pp. 26, 125-133.
1947-48. pp. 24-26, 85, 115-118.

Informe del Comisionado de Agric. y Comercio Division de Ornitolgia y Piscicultura.
1934-35. pp. 56-58, 298-304.
1935-36. p. 40.
1936-37. pp. 51-53, 172-178.
1937-38. pp. 56-60.
1938-39. (No reports this year).
1939-40. pp. 125-129.
1940-41. pp. 24-26, 123-126.
1941-42. p. 135.
1942-43. p. 25.

The Introduction of Rainbow Trout and bluegill sunfish into Puerto Rico.
1936. U. S. Department of Commerce Fisheries Service Bull., Washington, March 2, Number 250.

Inigo, Felix.
Past and Present salt fish situation in Puerto Rico.
(Unpublished paper kept at the Fishery Laboratory Library at Mayaguez, Puerto Rico.)
1949. *Introduction of North American Fishes into Puerto Rico.*
Revista de Agricultura de Puerto Rico, Vol. 40, No. 1, p. 107.

Jarvis, Norman D.
1932. *The Fisheries of Puerto Rico.*
U. S. Department of Commerce, Bureau of Fisheries, Investigational Report No 13, Govt. Printing Office, Washington, D. C.

Johnson, Fred. F., and Clarence R. Lucas.
1942. *Cooperative Possibilities in the fisheries of Puerto Rico and the Virgin Islands.*
Fish and Wildlife Service U. S. Dept of the Interior, 43 pp.

Jordan, David Starr, and Evermann, Barton Warren.
1900. *The Fishes of North and Middle America.*
U. S. Nat. Museum. Bull. 47, Pts. 1 to 4.

Knake, B. O., and Whiteleather, R. T.
1943. *Otter trawl net for small fishing boats.*
Fishery Bull. of Puerto Rico, Vol. I No. 2.

Labor Realizada por la Division de Pesqueria y Vida Silvestre en el mes de Septiembre, 1945.
Boletín Mensual del Departamento de Agricultura y Comercio, Vol. IV, No. 1 p. 18-19.

La Industria Pesquera:
1943. Boletín Mensual del Departamento de Agricultura y Comercio, Vol. II, No. 3 p. 1-2.

La Pesca Comercial en Puerto Rico.
1942. Boletín Mensual del Departamento de Agricultura y Comercio, Vol. I, No. 9 p. 7-8.

Ledru, A. P.
1810. *Voyage aux iles de Ténériffe, la Trinité, Saint Thomas, Saint-Croix et Porto Rico exécuté par l'ordre du gouv. franc, etc.*
2 vols., Paris.

Leyes Bajo las cuales funcionara el Plan de Pescas:
1944. Ley No. 157. Boletín de Pesca de Puerto Rico, Vol. 1, No. 3, p. 12-16.

Leyes de Caza y Pesca de Puerto Rico.
1945. Depto. de Agricultura y Comercio—División de Pesqueria y Vida Silvestre, pp. 1-3

Lobell, Milton J.
1943. *Las Pesquerías del Caribe y su Evolución.*
Boletín Mensual del Departamento de Agricultura y Comercio, Vol. II, No. Agosto. p. 9-13.
1945. *Theoretical Possibilities for Fish Abundance in Puerto Rico.*
Revista de Agricultura de Puerto Rico, Vol. XXXVI, No. 2, Julio-Septiembr p. 189-193.

Lucas, Clarence R.
1942. *The War and Puerto Rico Edible Fishery Imports.*
Published by Revista de Agricultura, Industria y Commercio de Puerto Ric vol. XXXIV, núm. 2, p. 212-222, tables.

Martin, Harry B.
1948. *Development of fresh water fisheries in Puerto Rico.*
Revista de Agricultura, vol. XXXIX, núm. 2, p. 218.

Mattox, N. T.
1949. *Studies on the biology of the edible oyster Ostrea rhizophorae Guilding in Puerto Rico.*
Contribution from the Department of Biology, U. P. R., College of Agric. & Mech. Arts, Mayaguez, Puerto Rico. (Reprinted from Ecological Monographs, vol. 19, pp. 339-356. October, 1949).

McCallan, Ralph S.
1949. *First Partial Report of the findings in research of game fishing of Puerto Rico.*
A publication of the Office of Tourism, San Juan, Puerto Rico. J. Stanton Robbins, Director.

Melendez Ortiz, M.
1946-47. *Annual report, Fisheries and Wildlife Division.*
Department of Agriculture and Commerce, San Juan, Puerto Rico.
1947. *Algunas observaciones sobre la pesquería en Puerto Rico.*
Boletín de Comercio, Departamento de Agricultura y Comercio, Año IV, Núm. 18, p. 6
1950. *Información relacionada con la pesquería de agua dulce en Puerto Rico.*
(unpublished).

New Fishery Research Laboratory in Puerto Rico
1939. Science (Sept. 22).

Nichols, J. T.
1915. *Stray notes from Puerto Rico.*
Trans. Amer. Fisheries Soc. for 1914. p. 159.
1915. *Fishes New to Puerto Rico.*
Bull. Amer. Mus. Nat. Hist., vol. XXXIV, pp. 141-146, 2 figs.
1929. *The Fishes of Puerto Rico and the Virgin Islands.*
(Branchiostomidae to Sciaenidae.) Scientific Survey of Puerto Rico and the Virgin Islands. N. Y. Acad. Sci., N. Y., vol. 10, pt. 2, pp. 162-295.
1930. *The Fishes of Puerto Rico and Virgin Islands—Pomacentridae to Ogcocephalidae.*
Scientific Survey of Puerto Rico and the Virgin Islands, vol. X, part 3, pp. 299-399.

Notas de interes.
1922. *La crianza de peces en la finca.* Informe del negociado sobre los resultados de la crianza de peces. Neg. de Pesquería y Vida Silvestre. Departamento Agricultura Industria y Comercio, vol. 8, p. 73 (Abril).

Oliver, Gonzales J.
1946. The possible role of the guppy, *Lebistes reticulatus* on the biological control of *Schistosomiasis mansoni.* Science, vol. 104, No. 2712, p. 605 (Dec. 20).

Operating Methods and earnings of Puerto Rican fisherman.
1943. Monthly Labor Review, pp. 57-145, (July).

Organizacion del Servicio de Pescas.
1930. Revista de Obras Públicas, vol. VII, No. 9, pp.238-241. (Sept.).

Perez Diez, Rafael
1943. *Facts about some of our most important food fishes.*
Fishery Bull., vol. I, No. 2. (June).

Pico, Rafael
1932. *La Industria Pesquera en Puerto Rico.*

Plan for the rehabilitation of the fishing industry of Puerto Rico.
1944. Fishery Bulletin of Puerto Rico, vol. I, No. 3 (Jan.).

Poey, F.
1881. *Peces.* En Gundlach, *Apuntes para la fauna puertorriqueña.*
Angles de la Sociedad Española de Historia Natural, Madrid, vol. 9, p. 243; vol. 10, pp. 317-350.

Problemas de la industria pesquera.
1940. Revista de Agricultura, Industria y Comercio de Puerto Rico, vol. XXXII, núm. 1, pp. 109-110 (Enero).

Puncochar, J. F.
1942. *Aims of the Fishery Research Laboratory of Puerto Rico.*
Revista de Agricultura, Industria y Comercio, vol. XXXIV, año XX, núm. 2, pp. 200-202. (Junio).
Reprinted in the Fishery Bulletin of Puerto Rico, vol. 1, No. 1, March (1943).

Puncochar, J. F., and Quinones, Luis R.
1943. *A method for the wet-salting of "mixed" fishes.*
Fishery Bull. of Puerto Rico, vol. I, No. 2 (June).

Puerto Rico studies fisheries of New England as pattern for its own.
1941. Revista de Agricultura, Industria y Comercio, vol. 33, No. 1, pág. 167 (Enero).

Quinones, Luis R., and Puncochar, J. F.
1943. *A method for the tanning of hand lines and nets.*
Fishery Bull. of Puerto Rico, vol. I, No. 2 (June).
1943. *Preliminary Report of Practical utilization of Mangrove Bark.*
Fishery Bull. of Puerto Rico, vol. I, No. 1 (March).

Quinones Chacon, B.
"Notas sobre los especies de peces introducidas en Puerto Rico." Boletín de Comercio, Depto. de Agricultura y Comercio. (año III, núm. 15) p. 12.

Reglamento de Pesca para proteger y fomentar la produccion de peces en Puerto Rico.
1936. *Regular la pesca y para otros fines.*
Proclama del gobernador de Puerto Rico. Gobierno de Puerto Rico, Depto. de Agricultura y Comercio, División de Pesquería y Vida Silvestre.
Boletín administrativo núm. 533 aprobado en 2 de dic. de 1936, según ha sido enmendado por los boletines administrativos núm. 831 del 22 de enero de 1943, núm. 952 del 24 de julio de 1945, núm. 992 del 3 de julio de 1946, y núm. G. E. 11 del 12 de abril de 1946.

Sacarello, Rafael.
1939. a. *El Departamento de Agricultura está poblando de peces las aguas dulces de Puerto Rico.* Revista de Agricultura, Industria y Comercio de Puerto Rico, vol. XXXI, No. 1, pp. 29-38. (enero).
1939. b. *El Deporte de la Pesca en Puerto Rico.*
Revista de Agricultura de Puerto Rico, vol. XXXI, No. 1, pp. 116-122. (enero).
1939. c. *La Pesca Comercial en Puerto Rico.*
Revista de Agricultura, Industria y Comercio de Puerto Rico, vol. XXXI, No. 3, pp. 451-461. (Julio).
1943. *"Boquerón como Indice de lo que puede esperarse de la Industria Pesquera."* Puerto Rico Illustrado. p. 52.

Silvester, C. F.
1915. *Fishes new to the fauna of Puerto Rico.*
Yearb. Carn Inst., Washington, vol. 14, pp. 214-217.

Soler, Pedro J.
1950 *A collection of fishes of the family Blenniidae, from Cay Sal. Bank.*
A thesis presented to the faculty of the graduate school of the University of Miami.

"Some of the more important fish in Puerto Rican Waters."
1950. Qué Pasa en Puerto Rico. Vol. 2, No. 15, Pages 28-29, July 1-15.

Stahl, A.
1883. *Fauna de Puerto Rico. Classificación sistemática de los animales que corresponden a esta fauna y catálogo del gabinete zoológico del Dr. A. Stahl en Bayamón.* pp. 1-249. San Juan.

Taylor, Harry E.
Possibilities for a shark fishing industry in Puerto Rico.
P. R. E. R. A.
Bureau of Agricultural and Industrial Research.

Thone, F.
1942. *Fishing at home.*
Science N. L. 41:109, February 14.

Torres, Miguel A.
1939. *"La Pesca en aguas de Mayaguez,"* Puerto Rico Illustrado, 27 de abril, año XXX, núm. 1518, p. 5.

Velez, Martin.
1943. Financial Analysis and Membership prob. of Corp. Pozuelo Inc. Univ. of Puerto Rico, Agr. Station Mimeog. Reg. No. 22, Oct. San Juan.

Velez Martin, Diaz Pacheco S., Vazquez Calcerrada, P. B.
1945. *La Pesca y Distribución de Pescado en Puerto Rico.*
Universidad de Puerto Rico, Estación Experimental Agrícola de Puerto Rico. Boletín 66, p. 45 (junio).

Vergne Roig, Pedro.
Economics of the fisheries and fishery resources of Puerto Rico.
Mimeographed publication of the Fishery Research Laboratory at Mayaguez, Puerto Rico. Fish and Wildlife Services, U. S. Department of Interior.
1942. *Problems in the Marketing and Distribution of Fish in Puerto Rico.*
Revista de Agricultura, Industria y Comercio, vol. XXXIV, año XX, pp. 203-204. (junio).
1943. a. *"A Comparative Economic Study of the Fishery Industries of the United States and Puerto Rico.*
A thesis presented to the faculty of the graduate school of the University of Maryland.
1943. b. *Report on the Analysis of Fish Statistical Data collected and its importance in the Fisheries of Puerto Rico: The operating of the Boquerón Freezing unit and recommendations resulting thereof on the light of data submitted.*
Statement submitted to the Chief, Division of Fisheries and Wildlife Conservation, Puerto Rico, Department of Agr. & Commerce, Puerto Rico. (unpublished).
1944. *"Profit and Loss Statement Bouquerón Freezing Unit. Jan. 1 to July 31, 1944."*
Submitted to the Chief Div. of Fish. & Wildlife Conservation, Puerto Rico, Department of Agr. & Commerce, Puerto Rico (unpublished).

"Un dia de pesca."
1937. Revista de Agricultura, Industria y Comercio. Vol. 28, pág. 621 (enero).

WALFORD, LIONEL A.
1947. *"Fishing Resources in Puerto Rico and the Virgin Islands, Fishery Resources, Hawaii and Puerto Rico."*
Fishery Resources of the U. S. Edited by Lionel A. Walford. Published by the Public Affairs Press, Washington, D. C., pp. 2 and 121-122.
WHITELEATHER, R. T.
1942. a. *Experimental operation of commercial fishing gear in Puerto Rico waters.*
Revista de Agricultura, Industria y Comercio, vol. XXXIV, año XX, núm. 2, pp. 208-209. (junio).
1942. b. *Results of a one-month Commercial fishery experiment in Puerto Rico West Coast Waters.*
Unpublished papers in the Fishery Laboratory Library at Mayaguez, Puerto Rico.
WILCOX, W. A.
1899. *Notes on the foreign Fishery Trade and local fisheries of Puerto Rico.*
Extracted from U. S. Fish Comm. Report for 1899. Doc. No. 418. Gov. Prtg. Off. Washington, p. 34.
1902. *The Fisheries and Fish Trade of Puerto Rico.*
Bull. U. S. Fish Commission for 1900. Vol. XX, pp. 27-48.

APPENDIX II

Publications On The Fisheries Of The Gulf And Caribbean Area, Published In 1950*

ANDERSON, A. W.
Effects of Various Chemical Compounds on the Survival of Several Species of Centrarchid Fishes, Ann. Rept. Mar. Lab., Texas Game, Fish & Oyster Comm, 1948-1949. pp. 51-83.
————*A Brief Review of the Literature Concerning the Effects of Turbidity and Silt on Fish.* pp. 247-251.

BAKER, B. B. JR.
Investigation of Reported Fish Mortality in Baffin Bay. Ibid. pp. 218-219.
————*Texas Game, Fish and Oyster Commission Fisheries Economic Survey of the Port Arthur Area—Preliminary Report.* Ibid. pp. 238-246.

BAUGHMAN, J. L.
The Great White Shark. Texas Game and Fish 8 (4): 16, 23.
————*Effect of Menhaden Operations. Seafood Business* 2 (10): 29-32, 36.
————*Suggestions for a possible Method Utilizing Waste Fish Resulting from the Shrimping Industry. Fish & Oil Industry* 2 (12): 9-10.
————*Fisheries Exploration in the Gulf of Mexico. Idem* 8 (9): 10, 29.
————*Marine Fishes of Texas. Introduction.* Idem 8 (6): 24.
————*Marine Fishes of Texas. Lancelets.* Idem 8 (7): 25.
————*Marine Fishes of Texas. The Sharks.* Idem 8 (8): 24.
————*Marine Fishes of Texas. The Nurse or Cat Shark.* Idem 8 (9): 22.
————*Marine Fishes of Texas. The Dogfish, Dog Shark, or Smooth Dog.* Idem. 8 (10): 22.
————*Marine Fishes of Texas. The Tiger Shark.* Idem 8 (11). In press.
————*Marine Fishes of Texas. The Sharp-nosed Shark, Newfoundland Shark.* Idem 8 (12). In press.
————*Marine Fishes of Texas. The Lemon Shark.* Idem 9 (1). In press.
————*Time for Sanity in Conservation. Seafood Business* 3 (1): 17-18, 110.
————*The Texas Shrimp Fishery and its Management. Southern Fisherman,* 10 (8): 173-174.
————*The Effects on Oysters of Sedimentation Caused by Dredging Operations in Copano Bay. Southern Fisherman* 10 (8): 173-174.
————*An Easy Method of Identifying Menhaden (Brevoortia spp.) in the Stomach Contents of Fish. Rept. Texas Game, Fish & Oyster Comm.,* p. 93a.
————*Meal and Oil Analysis of Trash Fish. Rept. Texas Game, Fish & Oyster Comm.,* p. 170.

BAUGHMAN, J. L., AND STEWART SPRINGER
Biological and Economic Notes on the Sharks of the Gulf of Mexico with Special Reference to those of Texas and with a Key for their Identification. Amer. Mid. Nat. 44 (1): 96-152.

BAUGHMAN, J. L., AND B. B. BAKER, JR.
Oysters in Texas. Idem 29: 1-37.

BREUER, JOSEPH P.
A Report on the Effects of Port Arthur Menhaden Fishery on Food and Game Fish for the Period of June 6, to September 9, 1949, Inclusive. Rept. Texas Game, Fish & Oyster Comm., p. 84-93.

BURKENROAD, M. D.
Review, The Effect of Fishing on Stocks of Halibut in the Pacific. W. F. Thompson, University of Washington Press, 1950. Texas Jour. Sci. Vol. II, No. 3, pp. 438-441

Caribbean Commission. Year Book of Caribbean Research 1949 Supplement Agriculture Fisheries and Forestry.

DAUGHERTY, F. M., JR.
The Effects of Sodium Acid Pyro-phosphate on Ostrea virginica, *(Gmelin.) Texa Jour. of Sci.* 2 (4): 539-540.
————*Mullet Fishing. Rept. Texas Game, Fish & Oyster Comm.,* pp. 228-234.
————*Blue Crab Investigation* 1948-1949. *Rept. Texas Game, Fish & Oyster Comm.* pp. 356-441.

DAVIS, C. C., AND R. H. WILLIAMS
Brackish Water Plankton of Mangrove Areas in Southern Florida. Ecology, Vo 31, No. 4.

Florida State Board of Conservation Oyster Division Monthly Reports.

Florida State Board of Conservation Quarterly Report on Fisheries Research.

*Fishery workers are asked to send reprints of articles published on the Gulf & Caribbea Fisheries to J. L. Baughman, Texas Game, Fish & Oyster Commission, Rockport, Texas fo inclusion in future lists.

FREESE, LEONARD R.
Marine Plankton Diatoms of the Rockport, Texas Bay Area. 101 pp. Northwestern Univ. Dissertation.
GUNTER, G.
Seasonal Population Changes and Distributions as Related to Salinity, of Certain Invertebrates of the Texas Coast, Including the Commercial Shrimp. Pub. Inst. Mar. Sci., Vol I, No. 2, pp. 7-51, 1950.
————*Correlation Between Temperatures of Water and Size of Marine Fishes on the Atlantic and Gulf Coasts of the United States.* Copeia, No. 4, pp. 298-304.
HARDCASTLE, A. B.
Additional Literature on the Menhaden. Rept. Texas Game, Fish & Oyster Comm., pp. 94-100.
HASKELL, WILLIAM L., AND A. W. ANDERSON
An Investigation of the Possibility of Determining the Age of Sharks Through Annuli as Shown in Cross Sections of Vertebrae. Rept. Texas Game, Fish & Oyster Comm., pp. 212-217.
IDYLL, CLARENCE P.
A New Fishery for Grooved Shrimp in Southern Florida. U. S. Fish & Wildlife Serv., Comm. Fish. Review, Vol. 12, No. 3.
————*The Commercial Shrimp Industry of Florida. Florida State Board of Conservation.* Educational Series No. 6.
————*Report on the Present Status of the Franklin County Shrimp Industry. Florida State Board of Conservation.* Mimeo.
————*Report on the Newly Developed Key West Shrimp Industry. Florida State Board of Conservation.* Mimeo.
INGLE, ROBERT M.
Summer Growth of the American Oyster in Florida Waters. Science, Vol. 112, No. 2908. September.
KEMP, ROBERT J.
Report on Stomach Analysis from June 1, 1949 *Through August* 31, 1949. *Rept. Texas Game, Fish & Oyster Comm.,* pp. 101-127.
————*A Comparative Study of Brackish Water Fishes. Thesis, Univ. of Texas, typewritten.* 45 pp.
LANE, CHARLES E.
A Noncarotene Provitamin A for Fishes. Science, Vol. 111, No. 2887.
MACKIN, J. G., H. MALCOLM OWEN, AND ALBERT COLLIER.
Preliminary Note on the Occurrence of a New Protistan Parasite, Dermocystidium marinum n. sp. *in* Crassostrea virginica (Gmelin). Science, 3 (2883): 328-329.
MILES, DEWEY W.
A Study of the Food Habits of the Fishes of the Aransas Bay Area. Rept. Texas Game, Fish & Oyster Comm., pp. 129-169.
————*The Life History of the Sea Trout. Texas Game & Fish* 8 (11): 16-19.
REYNOLDS, ERNEST S.
Pullularia as a Cause of Deterioration of Paint and Plastic Surfaces in South Florida. Mycology, Vol. XLII. No. 3. May-June.
RIVAS, LUIS R.
A Revision of the American Clupeoid Fishes of the Genus Harengula. Proc. U. S. Nat. Mus., Vol. 100, No. 3263.
ROBERTSON, ROY L.
Observations on the Growth Stages in the Common Blue Crab, Callinectes sapidus *Rathbun with Special Reference to Post-larval Development. Rept. Texas Game, Fish & Oyster Comm.,* pp. 172-211. Univ. of Maryland. Thesis.
SIMMONS, ERNEST
Operation Fishtrap. Texas Game & Fish. 8 (10): 6-9
SMITH, F. G. WALTON
Sponge Cultivation. Univ. of Miami Marine Laboratory, Special Service Bulletin No. 3
STEPHENSON, T. A., AND ANNE STEVENSON.
Life Between Tide Marks in North America. I. The Florida Keys. Jour. of Ecology, Vol. 38, No. 2.
VOSS, GILBERT
Two New Species of Cephalopoda from the Florida Keys. Revista de la Sociedad Malacologica Carlos de la Torre, Vol. 7, No. 2. July.
WILLIAMS, R. H.
Florida Seaweeds and their Commercial Use. Florida State Board of Conservation, Educational Series, No. 7.
WILSON, WILLIAM B.
The Effects of Dredging Oysters in Copano Bay, Texas. Rept. Texas Game, Fish & Oyster Comm., pp. 1-50.

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